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PRELIMINARY OBSERVATIONS ON THE CHEMICAL COMPOSITION OF FISH PONDS AND THEIR RESULTANT CROP OF *TILAPIA* SPECIES

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INTRODUCTION

A considerable body of information is available regarding the beneficial effect of pond fertilization on fish crops (Mortimer, 1955). Composition analyses are also available for many fish species, especially those of commercial importance. Data are few, however, relating pond fertility to fish composition. This is partly due to the fact that analyses of fish are often made on particular tissues for especial purposes. It is known that the chemical components of different tissues vary in the same fish. It has also been shown that different parts of the same tissue differ chemically, e.g. herring muscle (Brandes and Dietrich, 1953). For these and other reasons, many published analyses of fish tissues are of doubtful value for assessing either the demands a fish makes on its environment or the effect of the environment on the composition of the fish. The present series of simple, direct analyses of water, mud and whole fish was made in order to obtain some idea of the possibilities and scope of such work from this point of view.

MATERIALS AND METHODS

Table 1. gives some details of the ponds and the fish that were used. Most of the experimental material was obtained from a row of four 2 acre ponds (C1-C4), stocked with males only of *Tilapia mossambica*, of a closely related species imported from Africa and of their respective hybrids. The C and D ponds were being used for growth rate comparisons of the various breeds of *Tilapia* and were stocked with 1,000 *Tilapia* fry and 36 European carp/acre. These ponds were initially limed at the rate of 10 cwt./acre and mixed fertilizer was added at intervals during the six-month growth period to total 25 lbs. Nitrogen, 18 lbs. Phosphate, and 10 lbs. Potassium/acre. Pond F7 was treated with lime only and was used as a breeding pond from which stocks of young fish were netted as required. A4 and F4 were untreated, fallow ponds with acid water and supported a typical acid swamp vegetation. A few *Tilapia* fry had been accidentally introduced into A4 and 5 fish were recovered for analysis after 6-9 months. S is a small covered concrete tank holding about 1,000 litres of water. The four fish stored in this tank were obtained from a fertile pond and starved for six weeks before analysis. Faeces were collected daily and there was a constant flow of aerated rain-water through the tank.

The pond muds were sampled with an open ended glass tube (cross section, 6.75 sq. cms.) after the water level had been lowered from 3 feet to 1 foot before harvesting the fish. The tube was plunged into the mud to a depth of about 10 cms. and then carefully dug out. A cork piston

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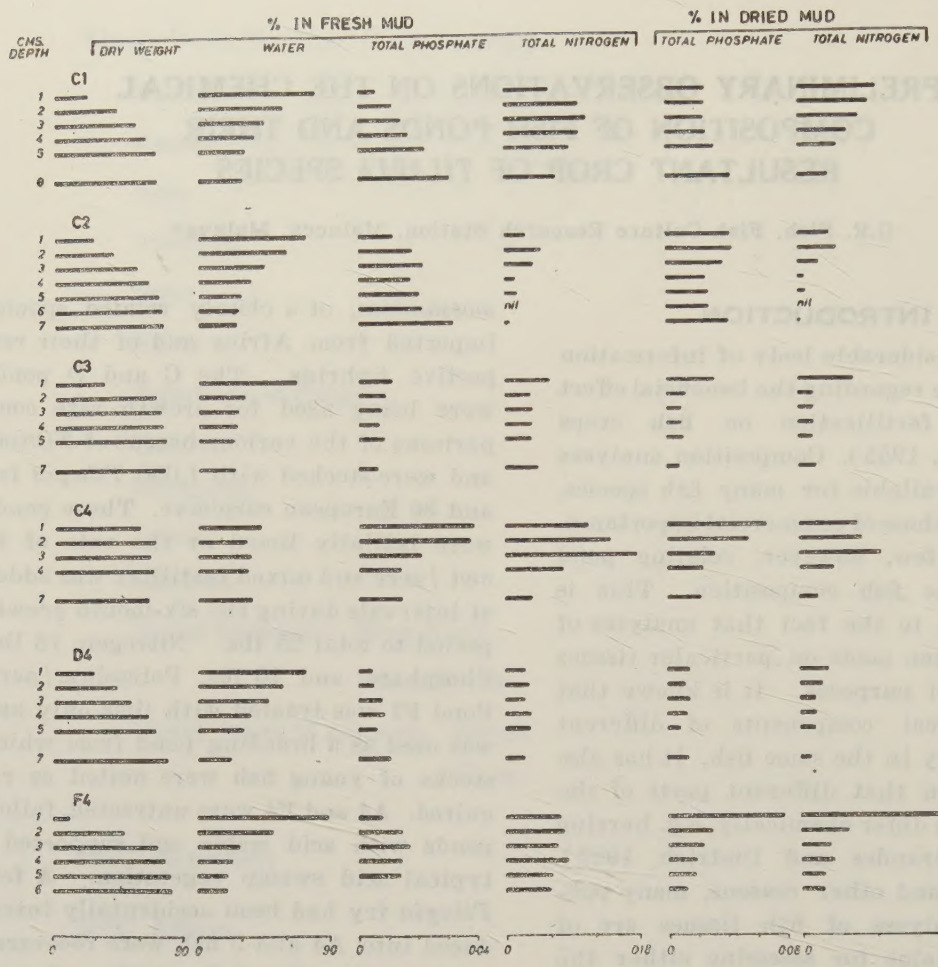

Fig. 1.

Figure 1 : Analyses of mud layers collected from six ponds.

forced the mud core along the tube and slices, 1 cm. thick, were cut off as the core was extruded from its upper end. Five sampling points were chosen in each pond and the slices from each layer pooled for analysis. Total nitrogen and phosphate were estimated as for the fish analyses below.

Although no pond was more than two years old, some stratification was evident from the varying colour of the mud core. The first cm. was, in all cases, mainly composed of a brown organic floc. This was followed by a black or dark brown layer, about 2 cms. thick, composed largely of clay with an organic fraction and sometimes smelling of hydrogen sulphide. Grey or fawn clay was found from the 4th cm. downwards and in some of the ponds (F4, D4, C3 & C4), coarse sand occurred together with the clay at about the 7th cm.

About 50 fish were netted from each pond with the exception of A4 where

this proved impossible owing to the low density of fish there. Any female fish were discarded and the largest specimens were selected to make up the samples of over 300 gms. of "large *Tilapia*". Fish between 8 and 12 cms. were then taken to make up samples of over 150 gms. of "small *Tilapia*". Although the smaller fish were not easily netted, this selection of large and small fish was made in order to discover any effects of size (or age) in the analyses. Each specimen was then killed (Fish, 1959), weighed and measured. Each group of large or small *Tilapia* was weighed, minced. dried at 100°C for 20 hours, reweighed and pulverised.

The fat was extracted from the sample in a Soxlet extracter for 4 hours using petroleum ether, B.P. 40°C. It has been pointed out by Love (1957) that petroleum solvents cannot split fat-protein linkages, therefore these results may all be low. Aliquots of the fat-free residue were used to determine total nitrogen (Beet, 1955). A value for crude protein was calculated from the total nitrogen results using the factor, 6.25. Dietrich (1953) has criticised the use of this factor for protein estimation in herring fillets. Further work along these lines may show that the present estimates of protein are all slightly too high. Total phosphorus was determined as phosphate after digestion of the fat-free powder (Tunnicliffe, 1955) and potassium was estimated on part of this solution using an E.E.L. Flame Photometer. Chloride was determined, using the mercuric nitrate method (Standard Methods, 1955), on the solution resulting from boiling an aliquot of the fat-free powder in distilled water for 30 minutes.

RESULTS

Fig. 1 shows some mud analyses from a typical series of ponds. All these ponds were excavated down to a clay stratum but all, except D4, supported a certain amount of swamp vegetation during the intervening period until they were mowed and limed prior to their use as fish ponds. The bottom of D4 was composed of firm white clay and, although it contained water for a year before use, no vegetation developed and the water remained clear until fertilization.

F4 is a fallow; permanently unfertilized and unstocked pond. It was sampled in the present instance because it was closely similar to A4 which could not, at that time, be sampled. The relatively high content of combined nitrogen and phosphorus in the first cm. in F4 reflects the infertile nature of the pond. The somewhat acid water (pH 5.9. Ca 0.4 p.p.m.) in this completely untreated pond has retarded the mineralisation of organic matter. The humus in the first cm. of the bottom mud contains large amounts of potential plant nutrients which are unlikely to become available until the processes of decomposition are started by liming etc. Neighbouring ponds, which were originally similar, responded well to liming for the natural fertility of all these ponds is high (estimates of productivity of some D and F ponds are given by Fish, 1958).

The fish crops obtained from the C and D ponds form a convenient criterion for assessing their relative fertility. These are given in Table 2. The water analyses show that the pH. and calcium content of all these ponds were 6.7-7.2 and 6-10 p.p.m. respectively. However, C4 and D4 are clearly the least productive ponds. The mud of C4 contained rela-

TABLE 1.

Pond No.	Description	Parent Fish Male/Female	Size range in cms.	Weight range in gms.	Number Analysed
S	Concrete tank	Malay/Malay	16.1 8.4-9.1	45 10-12	1 3
C1	2 Acre pond	African/Malay	19.1-26.6 9.0-9.8	106-139 12-17	3 12
C2	,,	Malay/African	13.5-14.0 8.2-11.0	48-174 11-25	4 10
C3	,,	African/African	23.6-24.5 9.8-11.5	216-268 12-32	2 10
C4	,,	Malay/Malay	15.0-17.8 8.0-11.1	52-95 12-23	3 9
F7	½ Acre pond	Malay/Malay	15.3-17.1 8.1-10.6	56-72 10-19	6 13
A4	4 Acre pond	Malay/Malay	5.2-15.9	3-58	5
F4	½ Acre pond				
D4	2 Acre pond				

Details of the ponds and fish from which analytical data were collected.

TABLE 2.

Pond No.	Large *Tilapia*	Small *Tilapia*	Potassium in fish	Phosphate in fish	Phosphate 1st cm. mud	Phosphate 2nd cm. mud	Phosphate 3rd cm. mud
C1	364	109	1.25	10.0	10.0	26.2	30.4
C2	591	66	2.13	14.75	18.0	38.1	54.5
C3	102	559	1.625	9.92	16.1	25.2	21.8
C4	109	13	0.424	4.1	78.0	132.0	64.0
D4	147	16	–	–	2.7	5.3	12.8

The total crop of *Tilapia* and the total weight of potassium and phosphate fixed in the fish crop and in the first 3 cms. of the bottom mud. All results are in lbs.

tively large amounts of plant nutrients, especially in the upper layers. The percentage of water in the mud remained fairly constant indicating a lack of organic material at the interface. Inorganic nutrients, however, are strongly absorbed on to clay particles and are therefore not easily released for utilization by phytoplankton. The white clay which formed the bottom of D4 contained, in any case, only small amounts of phosphate and nitrogen and the water remained white and turbid throughout the experiment. The natural fertility in this pond is likely to be limited by this factor alone. Both *Tilapia* (Fish, 1955) and carp (Vaas, 1957) tend to consume organic bottom debris. The accumulation of organic material on the bottom of the other ponds is, no doubt, partly responsible for their greater fertility. However, it is clear that these inorganic analyses, whilst being of considerable value for supplementing other data, cannot in themselves give any real indication of pond fertility.

The analyses of fish samples from the different ponds is given in Fig. 2. The variation in composition that is due to differences in pond fertility is here complicated by differences in the size, age and genetical constitution of the fish concerned. Certain of the results, however, may be related to the treatment of the ponds.

The low fat content of the starved fish and those from A4, which is an infertile acid pond, is understandable insofar as these fish are undoubtedly suffering from lack of food. There is, however, also a remarkable disparity in fat content between large and small fish in all the ponds. This seems to be related to their relative density in the ponds concerned. The proportion, by weight, of small to large *Tilapia* harvested in C1, C2 and C4 is 0.5:1, 0.11:1 and 0.12:1 respectively (see Table 2). On the other hand, in pond C3, the proportion is 5.8:1 and, although pond F7 was never completely harvested, breeding was unrestricted and, at the time of sampling, it contained a large population of fry and young fish which far outnumbered the initial stock of about 40 mature adults put in some months previously. It may be possible to explain these results in terms of dissipation of fat in the adults due to their breeding activities or of the more successful grazing of the available food by the younger and consequently, smaller-mouthed fish. In support of the latter explanation, is the personal observation that when young fish are feeding, they frequently turn sideway to graze on the epiphytic algal flora growing on the stems of aquatic plants. Larger fish have not been observed to do this and, indeed, it is likely to be a difficult manoeuvre for them in a well grown fish pond.

The phosphate analyses show that starved fish and those from A4 are low in phosphorus content compared with the others. Such a deficiency may reflect a lack of internal phosphate control and subsequent loss under starvation conditions. However, in no case did the fish seem unhealthy and it is more likely that those living in a favourable environment can store phosphorus beyond their immediate requirements. Analyses of fish tissue from uncultured marine fish by other workers (de Carvallo Rios, 1954 and Dyer *et al* 1958) show values ranging from 0.1 to 0.7% phosphate. Under the present conditions of culture, the natural fertility of the medium is enhanced and more phosphorus is available to the aqua-

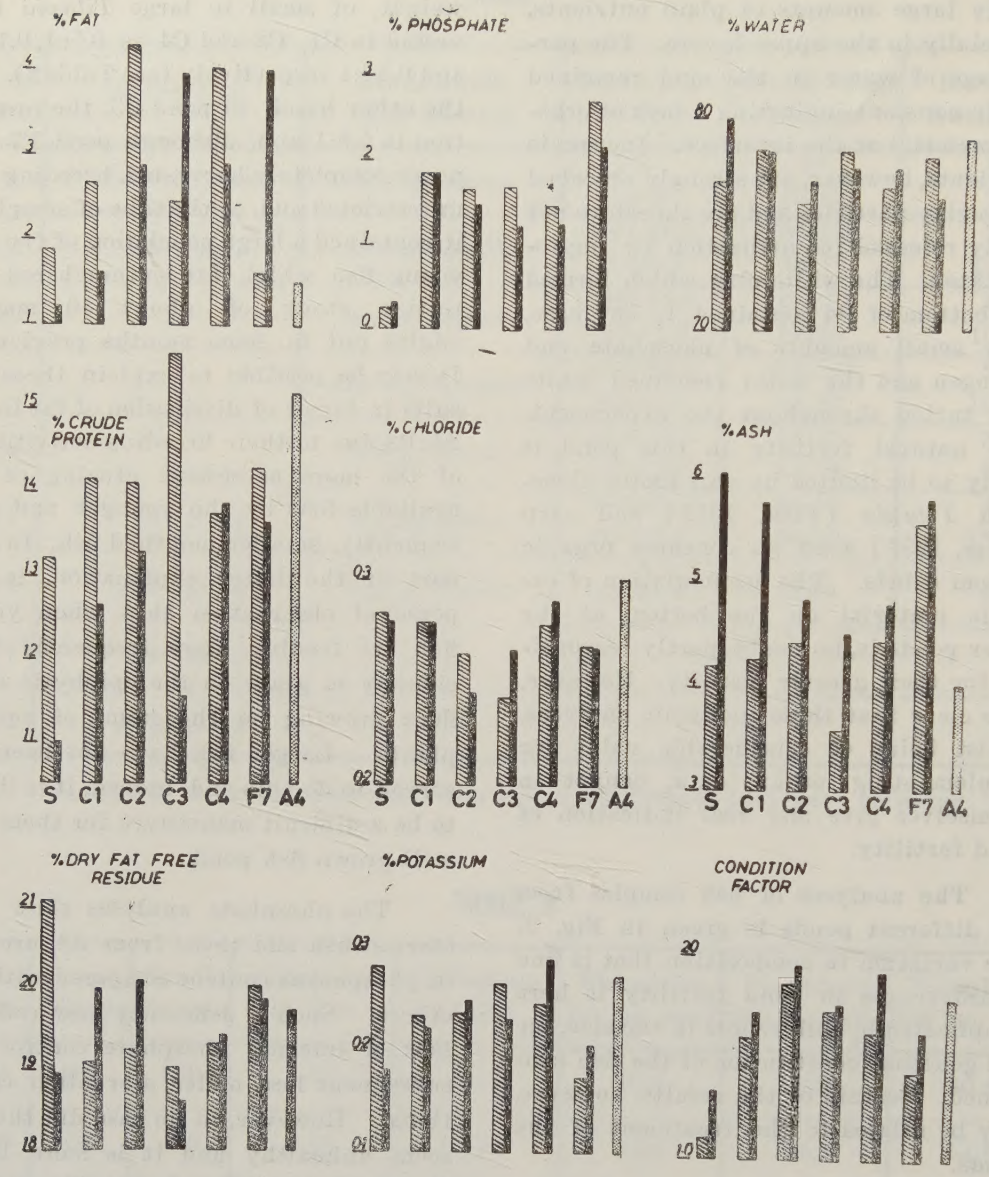

Fig. 2.

Figure 2: Analyses of whole fish from 7 ponds.
Results from Large fish—hatched histograms.
Results from Small fish—solid histograms.

TABLE 3.

Size Range cms.	Wt. Range gms.	No. in Sample	Total Fresh wt. in gms.	Dry wt. gut. contents gms.
14.3-17.1	44-66	8	463	3.802
8.6-11.8	7-20	10	144.2	0.9728

mgms. composition of gut contents in 100 gms. fresh fish				
Dry wt. gut contents	Total Phosphate	Crude Protein	Chloride	Ash
821	136	103.5	5.84	416
675	50	65.75	4.93	468

Analysis of gut contents of 2 samples of *Tilapia* from pond F7.

tic organisms living in the fish pond, both plant and animal. It is interesting to recall the data collected by Mackereth, 1953, on the freshwater diatom *Asterionella formosa*. He found that these algae can accumulate soluble phosphate from a suitable medium and can use these stores for further growth in a virtually phosphate-free medium until the extremely low limiting internal concentration is reached of 0.06 mg./10^6 cells.

The other constituents of the fish show relatively little variation although the samples were grown under widely varying pond conditions. However, some of these small differences may be significant and, to facilitate comparison, only the top parts of the complete histograms are figured.

The water content is between 76 and 80% in all the samples. Such small variation as is apparent, is inversely proportional to the fat content. This may have some physiological significance for a similar relationship which has been found in other fish, e.g. herring (Brandes and Dietrich, 1953).

The protein constituent of the fish sampled varies, overall, from 11-16%. In each of the two size groups, the starved fish have least protein which indicates that a small proportion has probably been metabolised during the starvation period. In general, the larger fish appear to have a higher percentage of protein than the smaller ones. These results may be correlated with those of the ash analyses where the smaller fish are shown to have relatively more ash for they may be caused by the surface-volume relationship between bodies of a similar shape. In the one case, the larger fish have a relatively greater volume and hence may contain more muscle etc. (protein) and in the other, the smaller fish have a relatively greater surface

area and may contain more scale material (ash).

The content of chloride and potassium show that only small differences are found in all the fish samples. The concentration of dissolved substances was fairly uniform in all the ponds (water conductivity ranged from 60 to 120 Dionic units). In addition, *Tilapia* are likely to have an efficient osmoregulatory system for they can flourish as well in brackish water as in fresh. These data may account for the uniformity of the salt analyses. However, it may be relevant here to note that potassium fertilization of fish ponds has only a negligible to very slight effect on fish harvests as compared with, for instance, phosphate fertilization.

The condition factor* seems to be a good indication of the state of the fish insofar as the starved fish have the lowest ratios. It is of interest also, that the highest factor is found in the fish from C2 which gave easily the most valuable commercial crop. However, the fish in A4 have an average to high condition factor and A4, with its swamp flora and acid water etc., makes a very poor fish pond. It seems likely that these fish are not in such good condition as their factor indicates in view of their relatively low fat and phosphate content. Any conclusions, though, which are drawn from these calculations must be treated with caution for the consistently higher values obtained for the smaller fish over those from the larger, suggest that the shape of the fish is probably changing with either increasing size or age.

DISCUSSION

The fate of fertilizer that is put into fish ponds is of considerable interest both from an economic and a theoretical point of view. That of phosphate is of particular interest (Mortimer, 1955). In the present instance, the data collected show the probable distribution of certain elements that were the basis of the fertilizer treatment of the ponds. It can be calculated (see Table 2) that when about 300 lbs. of *Tilapia* are cropped, about 5-10 lbs. of phosphate are removed per acre. The amount of phosphate assimilated by the fish seems to depend on the fertility of the pond insofar as those fish which were starved and those grown in acid unfertilized ponds contained far less phosphate than the fish taken from fertilized and fertile waters. The total fish crops, however, show that large differences in fertility exist in the other ponds but the analyses show no simple direct relationship between productivity and total phosphate. The experiments and observations of Mortimer (1941) are of interest in connection with the present mud analyses. He found that the redox potential controls the movement of nutrients between mud and water in a lake. Under conditions of oxygenation, i.e. high redox potential, many dissolved substances, including phosphate, are strongly absorbed or in an insoluble form. Exchange is not prevented however. Calcium fertilization may be important here for Hepher (1958) has found evidence of considerable precipitation of calcium phosphate in the somewhat alkaline fish ponds of Israel. Hayes and Coffin (1951), using isotopic phosphate in a nonstratified lake, concluded that, although the ratio between dissolved phosphate and that in the mud

* $w = bl^k$ when w = weight; l = length; b = a constant; k = approximately 3.

may remain constant, an active exchange occurs between the water and its phytoplankton and bacterial flora in addition to a similar but slower exchange involving the higher plants, zooplankton, sediments, etc. (See also Hayes and Phillips, 1958). Now, the present analyses of total phosphate demonstrate the presence of large amounts of bound phosphate in the bottom mud. In view of the mobility of the phosphate ion, it may be possible to devise a fertilizer mixture containing an ion that would tend to be preferentially absorbed on the clays, thus displacing the bound phosphate.

The distribution of phosphorus in the fish itself is complex. That in phosphoproteins, nucleic acids, etc. is, in the present analyses, combined with that incorporated into bones and other relatively inert tissues. The fact that whole fish were analysed may lead to inaccuracies due to the presence of gut contents. The large amounts of mucus in the gut contents, together with other digestive secretions, make it difficult to separate the material derived from the fish from that derived from the pond. However, some analyses were made on the contents of the gut from two samples of fish taken from a fertile pond, F7. The figures are given in Table 3. The total phosphate in this material is high and variable but not sufficiently so to account for the major differences shown in Fig. 1, which indicate the marked disparity in total phosphate content between fish growing under favourable and unfavourable conditions.

When assessing the value of phosphate fertilization, the possibility that plants and animals may be able to store this element in their tissues, must be considered. This characteristic has already been demonstrated in *Asterionella* by Mackereth (1953). The comment by Hayes and Coffin (1951) that a proportion of the radio active phosphorus they added, was taken up immediately by the phytoplankton and also the present data, all suggest that storage may occur in a number of organisms.

CONCLUSIONS

Inorganic analyses of the pond water and mud (Fig. 1) do not give any indication of the relationship between pond productivity, in terms of fish harvested, and the major constituents of the medium. However, the data presented in Fig. 2 show that major differences in the fertility of the medium, especially those resulting in the production of plant food, e.g. results produced by manuring etc., are reflected in the relative constitution of the fish growing there. This seems most marked in the phosphate figures and there seems to be a possibility that some storage of this element may take place under favourable conditions in *Tilapia*. Further data are needed but there is no doubt that accurate measurement of the phosphate storage capacity of plants and fish under controlled conditions would enable fish farmers to approach pond fertilization in a more rational manner and with a fuller understanding than is, at present, possible.

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FISH FLOUR FOR HUMAN CONSUMPTION*

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Introduction

Economically underdeveloped countries have long needed an inexpensive source of animal protein for human consumption as a help in preventing malnutrition. The use of fish offers a possible way of alleviating this deficiency. A difficulty arises, however, in that in many of the countries where inexpensive protein is needed most, the means of preservation are least available. One approach to the solution of this problem is to dehydrate the fish in order to prevent spoilage. In the category of dehydrated fish is edible fish meal, or fish flour. Research programs therefore have been undertaken in several countries to produce a tasteless, odorless, white fish flour for use as a source of the required protein.

In this report, the following topics are discussed: problems encountered in the use of fish flour, nutritional importance, acceptance tests and processes of manufacture.

Problems Encountered

Some of the problems in using fish flour as a protein supplement are preservation consumer reaction and cost. The first two problems directly contribute to cost, since the process that makes the flour resistant to deterioration and renders it tasteless and odorless—and thus acceptable to the consumer—increases the cost.

Preservation: The keeping quality of fish flour depends primarily on the low oil content of the final product to prevent it from becoming rancid. The producer, in order to supply the needs of people in various countries, must furnish a flour that can resist deterioration when stored at high temperatures and under adverse conditions. One of his essential problems, then, is to make a product that is low in oil.

Consumer Reaction: In countries where people object to a strong fish flavor, the flour must be refined, deodorized, or manufactured in such manner that the final product is substantially flavorless (*Food and Agriculture Organization of the United Nations* 1954).

The product should be of such quality that it can be incorporated in quick breads, cakes, cookies, cereals, pastries and baby foods without lowering the appeal of these foods to the consumer.

Cost: One of the difficult problems to overcome is that of cost. A factor in cost that must be kept in mind is the loss in weight of the product due to removal of moisture and oil from the raw material. Owing to this removal, less than one-fifth as much fish flour as the weight of the raw material is pro-

*Reprinted from Commercial Fisheries Review, Jan. 1960.

duced. This means in general that the cost of fish flour is more than five times the cost of the raw material, since processing costs must be included as well.

The high cost of producing fish flour for human food, in contrast to the relatively low cost of producing fish meal for animal feed, results from the palatability, sanitation and aesthetic requirements of the consumer. Where fish flour must meet the strictest aesthetic requirements, costs will necessarily be high, since only the more costly portions of the fish can be used.

Van Veen (1959)[1] reports: "A good defatted and deodorized fish flour, on a protein basis, should not cost to the consumer in underdeveloped countries much more than he would pay for dry skim milk in the same area. As for the U.S.A. we have been assured by an American firm that a partially deodorized fish flour costs about 36 to 38 cents a kilogram.[2] We think that a price of 24 to 40 cents per kilogram is realistic."

Nutritional Importance

In any process of manufacture, the nutritional value of a food product may be reduced. Thus, there may be loss of vitamins and minerals, and the protein may be made less digestible.

Irving, Smuts, and Sohn (1952) compared white fish flour (86.2 percent protein) with bread as to true digestibility and obtained the following data: white fish protein 95.6, bread 93.8, and white fish protein and bread 92.1.

Analyses of bread made from enriched and unenriched brown flour and a comparison with daily requirement are shown in Table 1 (*Fishing Industry Research Institute* 1958).

Table 1—Analyses of Bread Made from Enriched and Unenriched Brown Flour and Comparison with Daily Requirement

Material and Requirement	Protein	Calcium	Phospho-rus	Thia-mine	Niacin	Ribo-flavin
	G./100 q.	(Mg./100 q.)				
Brown bread	9.0	50	160	0.3	2.0	0.13
Fish flour	80	7,000	4,500	0.13	5	0.22
2%-enriched brown bread	10.4	186	245	0.296	2.06	0.132
	G.	(Mg.)				
Daily requirement	70	800	900	1.5	15	1.8

Note: From Memorandum No. 89, Fishing Industry Research Institute, Cape Town, South Africa, 1958.

1. Personal communication from A.G. van Veen, Chief, Food Processing and Preparation Branch, Nutrition Division, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, Rome, Italy, June 18, 1959.

2. 2.2 pounds = 1 kilogram.

Biological value of pilchard fish flour and pilchard meal is shown in Table 2 (Willmer 1955).

In order that a standardized stable fish meal may be produced that is equal in chemical and biological value to the fish from which it is derived, Levin (1959) suggests: (1) the product must be made from the whole fish with no division of products into fish meal and fish solubles, (2) the fish must be defatted and dried at temperatures that will not damage the product, and (3) the fish meal must be standardized on the basis of biological value. Both an animal assay that is accepted by nutritionists as a measurement of protein quality and a biological measurement of the identified growth factors should be obtained.

Table 2—Biological Value of Pilchard Fish Flour and Pilchard Meal

Material	Net Protein Utilization	True Digestibility	Biological Value
Pilchard meal, factory produced . . .	61.6	86.8	71.0
Pilchard fish flour, prepared . . . . . in laboratory	62.6	82.6	75.8

Note: From *Eighth Annual Report of the Fishing Industry Research Institute*, Cape Town, South Africa, 1955.

The bulk or fiber content of the diet often may be a determining factor in the digestibility of protein incorporated in that diet (*Nutrition Reviews* 1955).

Sure (1957a) reports that fish flour was used in rat-feeding studies to determine the influence of this product on growth and protein efficiency. Small amounts of defatted fish flour were added to milled wheat flour, white corn meal, and polished rice. Gains in body weight and protein efficiency obtained were superior to those obtained in the past with dried nonfat milk solids, dried butter-milk, defatted soybean flour, brewers' yeast, cultured food yeasts and peanut meal.

He also reports (1957b) that rats used in feeding tests in which small amounts of defatted fish flour were added to whole yellow corn, whole wheat, whole and milled rye, grain sorghum and millet showed definite increase in body weight. The greatest responses were secured with grain sorghum, millet and whole yellow corn.

Acceptance Tests

Experiments on consumer acceptance of fish flour have been conducted in a number of countries, including Chile, Thailand and Mexico.

Chile: Each day for 6 weeks, 140 school children in Chile received, as part of their school lunch, a 90-gram bread roll made from wheat flour containing 10-percent fish flour. Taste, smell, form and consistency of the bread were normal, and the bread was only slightly darker than is that made from ordinary flour. There were no rejections or complaints

by the children, and no digestion trouble occurred (*Food and Agriculture Organization of the United Nations* 1954).

Thailand: An experiment, the results of which have not been published as yet, was carried out in the village of Nongkorn, Ubol Province, Thailand, to test the acceptability of fish flour by the people of the village. About 600 persons were given a daily ration of 15 grams of fish flour to supplement their scant intake of protein. This flour was made from "pla-tu" and "slipmouth" fish. About 5 tons of flour can be produced from about 28 tons of fish per day. Smaller fish, which previously had little or no market, can be used for the fish flour.

If this experiment proves successful, the flour will be made available to all villages of the province (FAO Bulletin No. 2).

Mexico: Levin (1959), citing the work of Frederico Gomez ("Studies on the Use of Deodorized Fish Flour in Malnutrition," *Boletin Medico del Hospital Infantil.* September 1958), reports that at a hospital in Mexico, the value of fish flour has been studied for two years, using methods of measurement such as nitrogen balance studies on children-comparing a corn-bean diet plus 10-percent fish flour with the same diet plus the nitrogen equivalent in the non-essential amino acid glycine. The results indicate that fish flour is of value as a dietary supplement.

Processing

Over the years, many methods for making fish flour have been tried. These methods are basically quite similar to those for preparing fish meal (in fact, as was indicated earlier, some authors use the terms fish meal and fish flour synonymously), but greater attention is given to the sanitary and aesthetic aspects.

As also was indicated earlier, one of the major ploblems that must be resolved is the oxidation of oil in the fish flour. Since the ordinary methods of producing fish meal leave considerable oil in the material, the product generally is not suitable for human use unless the starting material is very low in oil content.

For this reason, attention now has turned largely to a process of manufacture based primarily on solvent extraction. This process, of which there are a number of variations, is effective in removing oil.

Tentative Specifications for Solvent-Extracted Fish Flour:

The Food and Agriculture Organization and UNICEF, agencies of the United Nations, developed the following "Tentative Specifications for Solvent Extracted Fish Flour Defatted and Deodorized." These Specifications, dated June 12, 1957, remain in effect, although they are still tentative:

"1. Starting material shall be edible fish of a known species and in a condition fit for human consumption at the start of the process. The material to be processed shall be whole fish or whole degutted fish, or degutted fish with heads and tails removed.

"2. Handling of the fish from catch to end of processing shall be done with sanitary precautions ordinarily applied in producing human food. The fish may be dried either during the process of solvent extraction or by a preliminary stage of air drying. In either case, tem-

peratures shall be kept sufficiently low to avoid protein damage. In general, temperatures in excess of 212°F. will result in definite damage. Lower temperatures may cause some damage under certain circumstances.

"3. Finished flour shall meet the following specifications:

"Protein (Nx6.25): content 70 per cent minimum, digestibility 90 per cent mininum, biological value 70 per cent minimum.

"Amino Acids: Minimums of lysine 9.5 per cent, tryptophan 0.9 per cent, methionine 3.0 per cent, cystine 1.0 per cent (all as per cent of protein).

Moisture: maximum of 8 per cent.
Fat: maximum of 0.4 per cent.
Ash: maximum of 18 per cent.

Particle size: 100 per cent of the flour shall pass a 100-mesh screen.

"Color: not darker than a light gray or tan; ordinary bread baked with 1 part fish flour and 11 parts of ordinary white wheat flour will not show appreciable darkening.

"Odor and Taste: the flour shall have no more than a faint fish odor and taste; and when baked in bread as described above shall have no detectable fish taste or odor.

"Storage stability: after 6 months storage at temperatures prevailing in the area of intended use but not exceeding 100°F., and when packed in closed fiber or metal containers or in polythylene bags, the flour shall show no spoilage as judged by rancidity, mold growth, deterioration in biological value or 'flavor reversion' as judged by the criteria listed under odor and taste.

"Bacteriology: the flour shall be free of B. coli, Salmonella, and pathogenic anaerobes. The total bacterial plate count shall be not more than 2,000 per gram.

"Safety: no additives, preservatives or solvent residues are permitted. Safety tests in at least one species of animal shall be done according to requirements of the appropriate official agency of the country where the flour is to be used. (Note: FAO and WHO advisory groups have recommended 6-months studies in rats using diets in which the fish flour is the sole source of protein, and the test should include one reproductive cycle. If there is any reason to suspect safety hazards, more elaborate tests and additional species of animals may be required. These recommendations pertain principally to products intended as supplementary foods for infants and children.)

"4. Chemical methods shall be those of the American Official Agricultural Chemists or equivalent 'official' generally-accepted methods. Amino acids may be determined microbiologically using generally accepted methods such as those described in Barton-Wright, E.C. "The Microbiological Assay of the Vitamin B Complex and Amino Acids. "Pitman Publishing Corp., New York (1952), or chromatographically by the Moore and Stein procedure. Bacteriological methods shall be official methods of the American Bacteriological Association, the American Public Health Association, or equivalent accepted methods. Biological value may be determined by the Miller-Bender or the Mitchell methods."

Production: Some of the countries producing fish flour are South Africa, Canada, Great Britain, France and the United States. Closely allied products are manufactured in India, Germany and Russia. The process varies somewhat from country to country. References listed in

the appended bibliography should be consulted for details on actual manufacture.

South Africa: Scientists in South Africa have reported that they have developed a process for making tasteless and odorless fish flour, which now is being used to enrich brown bread (Indo-Pacific Fisheries Council, FAO 1957). The flour has a moisture content that varies between 2 and 3 per cent. It is light brown in color and contains no additives. The Fishing Industry Research Institute(1958) reports that the product is stable because of its low content of oil.

This fish flour has been incorporated to the extent of 5 per cent in bread, biscuits and rusks made of wheat flour (Fishing Industry Research Institute, S. Africa 1958). When the present plan is in full operation, about 5,000 tons of fish flour will be used each year (Indo-Pacific Fisheries Council, FAO 1957).

Canada: Guttmann and Vanderheuvel (1947) report that the fish flour manufactured at the Halifax Technological Station is almost white, odorless and tasteless and contains 2 to 3 per cent moisture, 2 to 5 per cent ash (mostly calcium phosphate), negligible amounts of lipids, and 94 to 98 per cent protein on a dry, ash-free basis.

Great Britain: British Patent 727, 072 provides a method of powdering fish, reported in *Food Manufacture* (1955), to be economical and to result in a product that is tasteless and odorless.

France: In France, the preparation of fish meal for human food consists primarily in eliminating oil from the fresh fish. It is reported in *Food Manufacture* (1956) that the fish flour produced by this method is tasteless and odorless.

United States: A plant in New Bedford, Mass., which uses an azeotropic solvent method, is apparently the only company in the United States producing fish flour at the present time. Whole fish—any species of any oil content—are processed into a fish flour reported to contain 70 to 80 per cent protein and less than 1 per cent oil. This company reports that their product can be processed to reduce its odor and flavor or to retain its odor and flavor, depending on the taste of the consumer, and it has good keeping qualities. The determining factors in producing the fish flour at a profit are cost of fish, cost of fuel and cost of labor (Viobin Corporation 1956).

A fish-processing company with branches in Eastport and Rockland, Me., recently announced plans to produce fish flour on a large scale. A spokesman for the firm reported that the flour will be suitable for use in such foods as bread and crackers (*The Fish Boat* 1959).

Anyone contemplating the manufacture of fish flour in the United States should first contact the U.S. Food and Drug Administration to make certain that his product can meet food requirements.

The Federal Food, Drug and Cosmetic Act defines a food as adulterated if it consists in whole or in part of any filthy, putrid or decomposed substance or if it is otherwise unfit for food. It is the view both of the Food and Drug Administration and of the consumer that the viscera of the larger fish are filthy and otherwise aesthetically objectionable. Similarly, the head, scales and tail of large fish are considered unfit for food. The Food and Drug Administration has not objected to the presence of tails and viscera in small herring canned as sardines as long

as the feed content of the viscera is eliminated. Another requirement of the Act is that food shall not be prepared, packed or held under insanitary conditions whereby it may become contaminated with filth or whereby it may be rendered injurious to health.

In view of the above considerations, the use of whole fish or fish containing viscera with feed in the intestines, even though heads and tails are removed, would be objectionable in the manufacture of fish flour or fish meal for human consumption. The Food and Drug Administration would not take exception to the use, for this product, of small herring that were free of feed and subject to all the conditions that control the use of herring in the canning of sardines.

India: Mohanty and Roy (1955) used the meat of sharks and rays to prepare a hydrolyzed fish-protein powder —a cream-colored, flourlike powder containing 85 per cent protein. They report that hydrolyzed fish-protein powder is soluble in water, that it keeps well, and that it is useful as a food for hospitalized patients and those suffering from malnutrition or duodenal and ventricular ulcers.

Germany: Shenstone (1953) describes a process for making Wiking Eiweiss, a soluble albumen made from fish that can be used as a substitute for egg white. Good-quality fillets of white fish are required for the preparation of this product. He reports that the final product is a slightly gray, odorless and tasteless, easily digestable powder. It may be used in aerated bakery goods, sugar confectionery, ice cream, mayonnaise, custard powder and pharmaceuticals.

Russia: Schimkat (1955) describes a method of producing dry protein from inexpensive varieties of small fish in the U.S.S.R. He states that the protein is a water-soluble, cream-colored powder with very little fishy flavor and that it contains 70 to 80 per cent protein, up to 10 per cent minerals, 0.5 per cent oil, and up to 10 per cent moisture.

Summary

1. Some of the problems encountered in the use of fish flour are preservation, consumer acceptance and cost.

2. The nutritional aspects of fish flour are currently under study.

3. Fish flour is reported to meet consumer acceptance.

4. The basic process used in the manufacture of fish flour is solvent extraction.

5. A stable, tasteless, odorless, nearly white, edible fish flour is reported to have been produced.

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Source: *Commercial Fisheries Review*, vol. 22, no. 1, Jan, 1960

GENERAL TRENDS

Artificial Upwelling

Three methods of causing artificial upwellings in the ocean, in order to increase the abundance of plankton, and consequently of fishes, have been suggested by the Joint Committee on Oceanography of the American National Academy of Sciences and National Research Council. One of the suggested methods for stirring up deep-water nutrients is to place a nuclear reactor at a sufficient depth in the water and make it produce enough heat to cause a large quantity of water to be forced up by convention. Another technique which has been suggested is to sink a chain from a buoy or barge and attach to it at intervals very large metal flaps. The flaps would be moved by the currents at various depths and stimulate the water so that a vertical turbulence would be created. A third possible method would be to lower a long plastic pipe so that one end was close to the sea bed and the other near the top. Because deep water is always colder and frequently less salty than that at the surface, the denser deep water could be pumped upwards through the tube, being gradually heated by the water outside the tube as it rose. Once it had been started by a pump, the water would continue to flow by itself and result in a constant change in the position of the waters. To launch this plan the committee proposes the expenditure of an initial US$1,400,000 to test the feasibility of these three methods. (*Fisheries Newsletter*, Feb. 1960).

Naga Expedition to Southeast Asia

The research vessel *Stranger* of the Scripps Institution of Oceanography is at present concluding a 2-year oceanographic program in the Gulf of Thailand and the South China Sea under the auspices of the Thai and Vietnam Governments and the US International Cooperation Administration. The scientific leader of the expedition is Prof. Anton Bruun of the University of Copenhagen, Denmark, who was leader of the Danish round-the-world *Galathea* expedition. The purpose of the expedition is to conduct oceanographic and marine biological surveys of the Gulf of Siam and South China Sea, particularly with a view to assessing potential food resources of the area and also to train scientists from several countries in southeast Asia in the techniques of oceanography. It should be mentioned that the expedition is collaborating with the UNESCO-organized training course in marine sciences at the Institut Oceanographique de Nhatrang. The Gulf of Siam and the adjacent part of the South China Sea comprise the largest semi-enclosed body of shallow ocean water in the world. In this area of about 500,000 square kilometres, the water is nowhere deeper than 200 metres (UNESCO *Marine Sciences Newsletter*, March 1960).

International Indian Ocean Expedition

The International Indian Ocean Expedition is being organized under the non-governmental sponsorship of the International Council of Scientific Unions

(ICSU) and its Special Committee on Oceanic Research (SCOR). Scientists of several nations experienced in oceanographic research will staff vessels provided by marine research institutions of these several nations. It is reasonable to expect that vessels will be available from Australia, France, Great Britain, India, Japan, Union of South Africa, USA and USSR. Scientists from countries unable to provide vessels will be invited to work on the Expedition's ships. Every effort will be made to obtain active participation by each nation bordering the Indian Ocean. The period of peak activity of the Expedition will occur in 1962 and 1963. Preliminary plans will be completed by August 1960 and the first cruises will occur in late 1960. The Expedition will continue into 1964. A preliminary and tentative cruise pattern for the entire Indian Ocean has been agreed upon by members of SCOR and its national committees. To complete the pattern will require about ten ship-years of operation over a total of 180,000 miles.

The Expedition will carry out investigations in the following fields of science: Physical Oceanography; Chemical Oceanography; Marine Biology; Meteorology; Marine Geology and Geophysics.

The proposed research will provide fundamental and valuable scientific knowledge. Some findings will have direct and immediate bearing on economic development and human welfare, for fisheries, weather forecasting and navigation. Intensive training and experience in oceanographic research will be available to scientists of the participating countries. Possibly twenty vessels with facilities for about three hundred and fifty specialists will operate in the Expedition. The estimated cost of the Expedition amounts to US$6,500,000 which will be solicited from governments, international agencies and private foundations. Detailed plans for research in the several scientific disciplines are being prepared now and they will be discussed at the SCOR meetings in Copenhagen, July 9-20, 1960. Indonesia and other nations of the region have given notice of intent to participate in this expedition. (UNESCO *Marine Sciences Newsletter*, March 1960).

Tuna in Indian and Pacific Oceans

In recent years large-size tuna caught in the Indian and Pacific Oceans are decreasing in number and more small and medium fish are being caught. It is, therefore, necessary to change fishing methods to catch more medium and small size fish. Small and medium-size tuna have more mobility and the location of fishing grounds changes according to oceanic conditions. Ocean conditions are deemed important and each Japanese vessel is requested to report on its position and water temperatures in the area it is fishing to assist in assembling oceanographic data. In recent years the tuna catch ratio in the Indian and Pacific Oceans has been on the decline and exploitation of new fishing grounds has extended into the Atlantic Ocean. All operating Japanese tuna vessels have expressed concern over decreased catches and increased operating days to catch a full load of tuna. This condition is attributed to the fact that the catch of large fish is down and catch objectives should be shifted to small and medium fish which are more abundant than large fish. Schools of small and medium tuna are usually thick, but they are so sensitive to water temperature that a very small variation in the Indian Ocean brings

about a change in their location. Accordingly, selecting fishing grounds becomes more difficult without proper oceanographic data. Despite the fact that tuna fishing operations have been going on for the past few years in the Indian and Pacific Oceans, there are few data available on seasonal changes in ocean currents in the sea areas where tuna fishing grounds exist. At present about 140 tuna vessels belonging to Shizuoka and Mie Prefectures are furnishing data which will be useful in assessing tuna fishing conditions. But in view of the great expanse of the Indian and Pacific Oceans, the data furnished are not adequate and the Tokai Fisheries Research Institute is calling upon vessels belonging to other prefectures to cooperate and is planning to put the collection of data on a nation-wide basis. (*Comm. Fish. Rev.*, Feb. 1960).

White-Blooded Fish

Russian scientists have discovered unique "white blooded" fish in the Antarctic. According to preliminary reports published by the Oceanographic Institute in Moscow, the research ship *Ob*, during its second expedition in the Antarctic, has made a discovery of extraordinary interest for zoologists : the scientists on board the *Ob* caught 18 fish whose blood contained no haemoglobin. The 18 fish belonged to 8 different species and in four of these species this colorlessness or "whiteness" of the blood was encountered for the first time. Four of these species were entirely new to science. It is pointed out that this condition among Vertebrata is unique since the presence of haemoglobin in the blood as carrier of oxygen is commonly accepted to be absolutely necessary for the sustaining of life. The Russian scientists have taken samples of this "white" blood of the fish to Russia in order to carry out further biochemical analyses and histological investigations. No explanation of this phenomenon has yet been given. (*The South African Shipping News and Fishing Industry Review*, June 1959), (CAB, *21*, 1958, p. 9).

Tilapia Culture

Experiments in Kenya showed a better growth rate in shallow (1 foot) and in clear water, as opposed to deep (2 feet) and turbid. At the 2 extremes shallow clear and deep turbid, the former showed 26% greater length and 43% greater weight of fish, the responsible feature being almost certainly water temperature which is maintained at a higher level for longer each day in clear and shallow water. This again results in a faster growth rate directly and a better diatom growth. Breeding and nesting enhance turbidity. Hence monosex culture promotes growth. Shallow ponds are more economical to establish and to operate. Danger is the greater liability to predation.

Ref: Someren, V.D. van and Whitehead, P.J. The culture of *Tilapia nigra* (Günther) in ponds. II. The influence of water depth and turbidity on the growth of male *T. nigra*. *E. Afr. Agr. J.* 25, 2, p. 66-72 (1959). (*Tropical Abstracts*, XV (4), p. 282, 1960).

Automatic Fish Egg Counter

The fecundity of fish has hitherto been generally determined by making direct counts of weight or volume subsamples of the total gonad contents. These counts are then raised by the ratio of the total weight or volume of the gonad contents to the sample weight or volume. This process is very time-

consuming, and, in consequence, routine studies of the fecundity of large numbers of fish have not been practicable. While typical fecundity estimates have been obtained for a large number of fish species, using material classified by size and age, and collected in one or two seasons, no detailed long-time investigations have been conducted. Such investigations could be of considerable value in studies of the biology and population dynamics of fish populations where it is desired to know the changes in fecundity from year to year, the factors determining these changes, and the dependence of recruitment and strength of year-class on these changes. To meet this need for routine measurement of fecundity (in the first instance of herring) an apparatus has been devised here. This makes rapid counts of all the eggs in a gonad, thus eliminating the tedious work of hand-counting, and also eliminating the errors of sub-sampling. The eggs are drawn in a stream of water through a constricted tube, interrupting a beam of light which is directed through it. The light beam falls on the cathode of a photomultiplier tube, and the interruptions of the beam are recorded on an electronic counter. The constricted tube, or counting chamber, has a minimum internal diameter of 1.53 mm., and it has been found that this is just large enough to pass the largest herring eggs without causing frequent stoppages. The photomultiplier tube used is an 'R.C.A. type 9314' with nine dynodes, and the light source is a 2.2-V., 0.25-amp. lens-end flash-light bulb. The counter is a 'Panax type D554' which conveniently supplies the E.H.T. for the photomultiplier (roughly 200 amp. at 1,000 volts) and an a.c. supply for the light source. A flow of bubble-free water is maintained from a constant-head tank through the counting chamber. Eggs to be counted are first cleared of all connective tissue and placed in water in the large glass funnel, and the stirrer speed is adjusted to bring them into suspension. The tap at the base of the funnel is then opened, and the eggs sink slowly downward and are swept through the counting chamber. The rate of sinking, and so the counting-rate, can be adjusted by varying the speed of the stirrer. In practice, a counting-rate of about 100 per sec. is found to be best. Attempts to increase this rate generally result in blockage of the system. A considerable number of trials have been made to gauge the accuracy and consistency of the counts. These results show that the maximum discrepancy between counts and the maximum error on known samples does not exceed 1 per cent. It is thus felt that reliance can be placed on the method, and a programme of routine investigations of herring fecundity is being developod accordingly. (*Nature*, 12 March 1960, p. 777).

Submarine and Underwater Behavior of Trawl

The third trip of the Russian fishery research submarine *Severyanka* was devoted principally to observing the behavior of the otter trawl underwater. The *Severyanka*, a Russian submarine converted for fishery and oceanographic research underwater, sailed on its third trip in April 1959. The operation required closed and delicate manoeuvering near the moving trawl. The submarine remained directly below the trawl for several hours while engineers observed and made motion pictures of its behavior. In all, the studies extended over several days. It is expected that the results of

the observations will aid in the design of new types of trawls. At times, the *Severyanka* settled to the bottom of the sea for observations of marine life. Work with hydroacoustical instruments made it possible to measure the zones of action of the echo sounders, that is, to explore the space around the submarine which is penetrated by ultrasonic energy and within the limits of which it is possible to detect schools of fish and other objects. The third trip of the submarine was one of many trips scheduled for several years. Preparations for a fourth trip were made in mid-1959. The *Severyanka* made its first trip in December 1958 in the region of Murmansk and its second trip, the herring fishing regions of the North Atlantic. Both of these trips resulted in much new and interesting scientific material. For example, the 24-hour behavior of Atlantic herring was studied. A number of oceanographic investigations were conducted. It was impossible, however, to observe the operation of the variable-depth or mid-water trawl used because of the poor visibility under water during the polar night. Scientists aboard also found out how bottom fish react to danger and tested the effectiveness of finding fish with hydroacoustical instruments. (*Comm. Fish. Rev.*, Jan. 1960).

Plastic Boats

In U.S.A., a firm is preparing to build a series of at least six plastic gill-net boats. The gillnetter hull's basic dimensions are 9.75 × 3.2 m. with expected carrying capacity of 4,000 fish and draft of 0.66 m. With a 175-h.p. Diesel it is expected to make 20 knots, using a 535 × 406 mm. propeller. The female mold for the glass hull has been built and production is to start soon. A great deal of interest has been shown in this preliminary work, particularly in the hull thickness, which varies from a minimum of 9.5 to 19 mm. The interior will be wood; only the hull, deck and cabin are of fiberglass, including built-in guards and a built-in recess, portside of the keel, for the heat exchanger, thus housed to prevent hanging-up of net and minimize water resistance. (*Pacific Fisherman*, Feb. 1960).

Pelagic Trawl

A new manoeuverable trawl has been successfully tested by Germany. The West German motor trawler *Rendsburg* during a trial trip to the Irish Sea and the English Channel tested a pelagic trawl which, like the floating trawl, can be set in any desired position in the sea. The experimental trip was a link in the West German ocean fishery's program for seeking new fishing grounds. The boat fished with various new pelagic, synthetic fiber trawls developed in cooperation with the Fishery Research Institute in Hamburg. Each trawl was directed by a sounding device which had an echograph on the headrope. This made it possible for the skipper on the bridge to check the depth of the trawl, the height of the opening, and even all the fish which passed the trawl opening. (*National Fisherman*, Feb. 1960).

Fish Transfer

Successful experiments have been carried out on the Bear Island fishing grounds in the transfer of fish from a Grimsby trawler, *Northern Wave*, to the *Northern Sea*. Fish, after being gutted are placed in special sausage shaped nets each of which holds about a ton. These "sausages", as they have been called, are marked and kept afloat by cylindri-

cal buoys of the type used by seine net fishermen and are strung together, again, like sausages. Experiments showed that the sausages could be lowered over the side of trawler and hoisted back again. The problem was whether another trawler could pick them up successfully, and the *Northern Wave-Northern Sea* experiment has shown that it can be carried out in northern waters. The obvious advantage of the system is that ships newly arrived at the grounds can transfer their first catches to another ship which is about to leave for home, "topping up" her catch until the fish-room is full and increasing the amount of best quality fish carried. The experiment also opens up the possibility of a deep sea revival of the old "fleeting" carried out in sailing smack days in the North Sea, though in those days the fish was transferred in the smack's open boats to fish carriers. Another possibility is that deep water trawling may develop into fleets of trawlers catching fish and transferring it to a large mother ship which will process and quickfreeze it. (*Fisheries Newsletter*, Feb. 1960).

Fish Fats and Heart Disease

Following up its successful research findings on the usefulness of fish oil fractions reducing high blood-serum cholesterol levels in animals, the U.S. Bureau of Commercial Fisheries has embarked on a stepped-up research and technical assistance program in this area. The plans include making available to interested medical and pharmaceutical researchers relatively large samples of purified fish oil fractions and the screening of 25 species of edible and industrial fish to determine whether the types of fatty acids present in these fishes are those useful in dietary and medical treatment of elevated cholesterol levels. Nutritional advisory services on fish oils and edible fish products are being made freely available to dieticians and medical researchers engaged in formulation of special anti-cholesterol diets. Large quantities of these oil fractions for human feeding trials have not been available. To remedy this situation, the U.S. Bureau of Commercial Fisheries is undertaking the preparation of such oil fractions utilizing a pilot-scale centrifugal molecular still and will make oil samples available, free of charge, to responsible researchers. The key findings of recent research which the Bureau hopes will encourage full scale clinical testing by responsible medical staffs are (1) the abundance of what are known as "unsaturated" fatty acids in the body oils of many species of fish, (2) proof that the feeding of these "unsaturated" fatty acids to test animals reduced the highly elevated content of cholesterol in their blood sera to "normal" levels, and (3) that the more "unsaturated" the fatty acid used, the more effective it was in normalizing levels of serum-cholesteral. This latter finding was of most immediate interest to fishery researchers since fish oil fatty acids contain up to six points of unsaturation in linoleic acid, the active cholesterol-depressant agent in vegetable oils. Use of a properly prepared concentrate of these highly unsaturated fatty acids from fish would permit effective anticholesterol treatment with a minimum of added fat intake. It is pointed out that these unique "soft fat" features of fish oils make fishery products especially valuable for inclusion in diets designed to bring about a better nutritional "balance" between the hard and soft fats in the American diet. Many medical authorities have pointed

out the desirability of increasing soft fat consumption as a possible means of controlling blood-cholesterol levels. (*Pacific Fisherman*, Feb. 1960).

Fish Biscuits

In India, fish biscuits with 12.5 per cent fish meal have been made for trial purposes. Specially prepared prawn pulp meal was used for this purpose. This product is very tasty, soft in texture and rich in protein. Carefully prepared prawn pulp meal contains as high as 70 per cent protein. This was mixed with flour, butter, sugar, baking powder, vanilla essence, hen's egg, lemon juice, milk and salt and beaten well. Afterwards it is rolled and cut into shape using moulds and baked at 175°-190°C for 30-45 minutes. In one set of experiments (A) fried fish meal was used and in another set (B) fresh fish meal was used. The product was similar in colour, flavour and consistency to the usual biscuits and the fish flavour was not at all predominant. The taste of sugar and the flavour of lemon, and vanilla completely masked the odour of prawns and organoleptically the fish biscuits were indistinguishable from the usual biscuits. The product was placed before the public in a few exhibitions and the consumer acceptance was good. Though the experiment was done only on a laboratory scale, it is expected that there should be no difficulty in expanding this work on a commercial scale. Though the experiments were done with prawn meal, any fish meal prepared carefully will be sufficient for making biscuits. Sardine meal, mackerel meal, silverbelly meal, etc., were later investigated and the biscuits prepared out of them were found to be very tasty. No complicated technique or apparatus is involved and the fish meal used in this preparation is inexpensive and easily produceable. Even the small bakery owners can produce fish biscuits on a large scale and the finished product will be only as costly as the ordinary brands of biscuits sold in the Indian markets. (*Fisheries Station Report and Year Book*— Department of Fisheries, Madras, India, 1955-1956, printed in 1959).

Seaweed Blood Substitute

For years researchers have been looking for a plentiful substance which can be substituted for whole blood or blood plasma in the giving of emergency transfusions to disaster or accident victims. The new discovery is a chemical derived from the tiny cells of brown algae that grow in colonies as giant brown seaweed. This whole blood substitute was reported by two Japanese surgeons of the Kyushu University Medical School in Fukuoka, Japan. Up to this time, an accident victim who lost a great deal of blood and received no transfusion went into shock, which could prove fatal. Hasty transfusions of whole blood or blood plasma usually prevents the rapid drop in blood pressure which produces this shock. In emergencies, injection of salt water or sugared water have been used for this purpose. The new mixture comprising water plus the seaweed chemical is said to be superior to salt water or sugared water for transfusions to prevent shock as it does not break down in the blood stream. (*Canadian Fisherman*, Feb. 1960).

NEWS FROM MEMBER GOVERNMENTS

AUSTRALIA

Use of Airplanes for Fish Spotting

There are now four planes regularly employed in Australia spotting fish. Fishermen of Lakes Entrance, Victoria, took delivery at the end of August 1959 of a £5,000 (US$11,300) Piper Super Cub aircraft imported from the United States. They bought the plane primarily for Australian salmon (*Arripis trutta*) fishing. When a worthwhile school is sighted, the plane calls the fishing boats by radio. A fishery firm and cannery of Sydney was the pioneer of commercial fish spotting by plane in Australia, and still regularly employs the Piper Cub aircraft which came to Australia on the Fijian tuna clipper *Senibua* in 1950. The plane pilot is paid a retainer and a bonus based on the amount of fish landed. At Lakes Entrance, an Auster plane is owned and operated by an owner of a salmon boat. In Western Australia, an Auster plane, owned privately by a cannery operator, is also used by him to spot "salmon" schools for fishermen who supply his canneries. A whaling company of Albany uses a chartered plane as required, to spot whales. The pioneer of whale spotting by plane in Australia was the company that operated the Station at Point Cloates. Since they took over the former Australian Whaling Commission station at Carnarvon and concentrated all their whaling from that port, they have not used aircraft, but they have an arrangement with an airline that when it next has a helicopter available, it will be used for experimental spotting of whales. (*Fisheries Newsletter*, Oct. 1959).

CEYLON

Merchanization

An additional 46 mechanized boats financed by Government Funds were launched during the months of April and May. Of the 46 boats launched, 17 were assigned to Fishermen's Cooperative Societies and 29 were given to individual fishermen. This brings the total number of merchanized boats financed by Government Loans to 253; i.e. 175 to individual fishermen, and 78 to Fishermen's Cooperative Societies. Most of the mechanized boats that were operating in the West Coast during the last fishing season have now migrated to the East Coast with the setting in of the South West Monsoon. A large number of boats from Negombo have, however, not migrated.

Engine Maintenance Course No. 16

An FAO Marine Engineering Superintendent attached to the Department of Fisheries conducted a course in the operation and maintenance of marine Diesels at Kalmunai from 18th to 30th April, 1960. Twenty-one trainees attended this course.

Training Course for Freshwater Fishery Officers

A refresher-cum-training course was held during 16-22 November 1959 for personnel in the Freshwater Division of the Fisheries Department. Lectures on the following subjects were read:

1. Limnology and Fish Production.
2. Other Animals Besides Fishes

Found in Fresh Water.

3. Fresh Water Fishes of Ceylon and Simple Methods of Identifying Species.
4. Statistics and Simple Statistical Measures.
5. Reproductive Habits, Embryology, Age and Growth and Migration of Freshwater Fishes.
6. Some Important Aspects in the Management of Nursery Ponds.

Also, Techniques for Determination of Dissolved Oxygen and Free Carbon Dioxide in Water Samples as well as Analysing of Plankton (Dry and Ash Weight) were daalt with.

INDIA

Gujarat Fisheries Department

It has been decided to establish a Department of Fisheries at Ahmedabad due to the formation of the new State of Gujarat out of the composite State of Bombay. Shri K.R. Srivatsa, I.A.S. ex. Collector and District Magistrate of Kaira has been posted as Director of Fisheries of Gujarat. The Department will have jurisdiction of the coast line from Umbergaon in Thana district to the boundary of Kutch inclusive of 17 districts. All correspondence on Fisheries pertaining to this area and the State of Gujarat should be forwarded to the Director of Fisheries, Municipal Maternity Hospital, Rakhial, Ahmedabad, Gujarat, India (Telegram "FISHERIES AHMEDABAD").

Shrimp Canneries

A small shrimp cannery in the fall of 1959 started to can shrimp in the small fishing village of Malpe, Mangalore, South Kanara, India. The equipment of the plant was designed and locally fabricated by its manager, a fisheries engineer. The cannery at Malpe has an output of about 3,000 cans per 8-hour working day, and is the second cannery in operation in India. A somewhat larger cannery, located, at Cochin, started packing shrimp in September 1958 and its capacity is rated at 12,000 cans per 12-hour working day. Both of the canneries put together are expected to pack annually nearly 2 million cans, valued at about Rs. 3 million (US$ 628,000) to the canners, for export to the United States.

The Marine Biological Association of India

The Marine Biological Association of India was formally inaugurated by the Hon. Mrs. Lourdhammal Simon, Minister for Fisheries and Local Administration, Madras State, on January 3, 1959. The aim of the Association is to promote interest in marine biological and cognate sciences. The following officers were elected:

Dr. S. Jones (president)
Prof. R.V. Seshaiya (vice-president)
Dr. R. Raghu Prasad (secretary)
Dr. C.P. Gnanamuthu (secretary)
Dr. R.P. Varma (assistant secretary)
Shri K.V. Rao (treasurer)
Dr. P.N. Ganapati (editor)
Dr. R. Subrahmanyan (joint editor)
Dr. S.V. Job (managing editor)

The official organ of the Association, the "Journal of the Marine Biological Association of India" is expected to be published half-yearly. Membership is open to all who are interested. All correspondence should be addressed to the Secretary, Marine Biological Association of India, Marine Fisheries P.O., Mandapam Camp, South India. (UNESCO *Marine Science Newsletter*, March 1960).

Fishermen's Credit Supply

Conforming to the aim of the Government to strengthen the economic-financial position of the small farmers and fishermen, decisions and actions have been taken during the years 1956-1958 to extend the channels of credit. For this purpose a Farmers' and Fisherman's Bank has been brought into existence. Credit, supplied to farmers and fishermen, must be channeled through autonomous local credit agencies upon recommendation of the local government. With the existence of these local credit agencies, the Farmers' and Fishermen's Bank does not come in direct contact with individuals or organizations which need the necessary credit. Another source of credit for fishermen is the Sea Fisheries Service, which distributed motorized vessels and twine to fishing industries as credit in the framework of rehabilitating fishing gear and mechanizing the fishing industries. The distribution of twine for nets and the supply of credit to purchase fishing material and gear, have been channeled through the Federation of Indonesian Fisheries Cooperatives, as long as the fishing industries are members of fisheries cooperatives. At the end of 1958 the Sea Fisheries Service had distributed motorized vessels on a hire-purchase system to: (a) fisheries cooperatives, 147 vessels, valued at Rp. 20,216,900; (b) organizations of war veterans, 48 vessels, valued at Rp. 6,469,950.

Mechanization of Fishing Industry

Through 1958, and dating back to 1955, there has been spent in Indonesia for mechanization of the fishing industry Rp. 94,169,600. According to recent figures, the number of motorized vessels in 1958 was approximately 1,320, most of which are owned by fishermen's organizations. It is necessary to point out that mechanization of fishing industries has become popular among the fishery communities in Indonesia.

Extension of Auxiliary Facilities

In the area of extension of shipyards and workshops a number of advances can be cited. Among them:

Establishment of a fishing harbor at Surabaja, East Java, under construction since 1952 and completed in 1958.

Shipyards and slipways for fishing stations at Djakarta, Ambon, Ternate and Belawan have been under construction for a number of years, and now approach completion.

Similar facilities at Tandjung Balai, North Sumatra, completed in 1958.

A fishery station is under development in Galala, Ambon, Moluccas, as are shipyard and slipway facilities at Gurapin, North Moluccas.

A shipyard and slipway project in Pulau Bayan, Central Sumatra, was expected to be finished by the end of 1959.

Fish Packing Plant Development

Projects under this heading include the following:

An ice plant with 20 tons daily capacity, established at Tegal, Central Java, by the Sea Fisheries Service and equipped with refrigeration machinery valued at US$ 50,000 and obtained from ICA. Given the status of a government corporation, this plant has made substantial profits.

A pilot cannery was established at Ambon, Moluccas, in 1956 and equipped

with machinery valued at US$ 20,000, obtained from ICA. This plant cans tuna, and was being expanded in 1959.

An ambitious project is that of Kotabaru, started in 1955/56 to expedite modernization of fishing activities in South Kalimantan, Borneo. It consists of a fish flour plant, cannery, ice plant, workshop and slipway, net loft, fish drying and fish salting plants and a training center.

This pilot project was designed to create a modern fishing community which could be used as a prototype for the development of others. Although it was finished in 1958, the project has encountered a number of obstacles, principally lack of equipment.

Experiments in fish canning have been under way since 1957, with satisfactory results. To provide raw material, the plant is served by nine fishing vessels, one shrimp trawler, and five carrier boats.

Total amount going into the plant to the end to 1958 was Rp. 17,614,000, of which Rp. 13,701,000 was capital investment and Rp. 3,913,000 operating funds.

Operation of the project is supervised by foreign experts provided by ICA.

Indonesian Fisheries Research

Scientific and technical research projects of Indonesia have been handicapped for lack of funds and facilities, notably a laboratory and research vessel, but include:

(a) Biology-Research on species of fish, several kinds of fisheries, plankton; research on exploratory fishing; research on pearlculture. (b) Fishing technique-Research on long-line-, shrimp trawl-, otoshi-ami-, muro-ami-, pearl-, lampara-fishing, trolling, etc. (c) Technology-Canning, experiments and artificial drying of fish. (d) Other researches-Among others, research on the efficiency of vessels and engines, oceanography and socio-economics.

Fishermen's Organization

Due to their pre-occupation with production and the sea, Indonesian fishermen generally have not handled the marketing of their products themselves and have been compelled to pass this business to their customers without taking into consideration whether the prices they realized were reasonable or not. This unfavorable situation can be overcome partly by making joint efforts in the form of cooperatives. It is obvious that a cooperative is the most suitable type of organization for the fishermen, due to the fact that basically fishing is a joint effort itself in Indonesia. Moreover, fishery cooperatives will be able to assimilate the technical developments for the sake of their members, by way of rationalization and modernization. Through the establishments of fishery cooperatives it is strongly hoped that the fishermen will gradually be able to decide what must be actually done with their own products. This can be achieved by way of: (1) setting up fish auctions in the first place; (2) setting up central places for fish salting and efforts of selling the product jointly; (3) marketing the fish directly to the consumers. Success has already been achieved in the setting up of fish auctions, which are mostly found along the coast of the island of Java.

Directory, Indonesian Fishery Organizations

Directorate of Fisheries-Ministry of Agriculture, Djalan Gadjahmada 8, Djakarta, Indonesia-Chief, R. Pranjoto.

Sea Fisheries Service-Ministry of Agriculture, Djalan Kerapu 12, Djakarta-Kota, Indonesia-Chief, R.A. Kartono; Division Chiefs; M. Soeparso Malangjoedo, Central Institute; R. Soenarto, Fishing Technique Research; J.R. Pattina-Sarany, Technological Research; R. Soedire Mangoendjojo, Motorization and Mechanization; Soekarno Joga-Wisastro, Credit and Fishermen's Organizations; F.W. Wawaroentoe, Marketing; B.B. Lokollo, Engines and Boat Construction; R. Soeroto, Education; V. Soesanto, Marine Resources Research; R. Koostedjo, Statistical; R. Mochamad Iskandar, Legal; R.M. Soepanto Koesoemowinoto, General Technical and Foreign Relations.

Farmers and Fishermen's Bank, Djalan Nusantara 18, Djakarta, Indonesia-Managing Director, G.M. Charidjie Kasuma.

Federation of Indonesian Fisheries Cooperatives, Djalan Lodan 143. Djakarta, Indonesia-Chairman, R. Eddiwan. (*Pacific Fisherman - International Yearbook Number* 25, January 1960).

JAPAN

Japan is a narrow and mountainous island country and so has a long coastline. Oceanographic conditions are favorable for fisheries, Two sea currents, cold from the north and warm from the south, meet in the waters near Japan. With these conditions and an active seafaring people, Japan has become the leading fishery nation.

Because the rugged topography of the land only a small area is available for grazing, and due to the shortage of fodder the Japanese people cannot rely on the livestock industry as a major source of their animal protein intake. Their main source of animal protein is the sea, which supplies about 90% of the animal protein requirements of the rural population and about 80% of that of the urban population.

Aside from contributing directly to the food supply of the country, the fishing industry occupies a very important position in Japan's economy and a considerable amount of marine product is exported. For instance in 1957, Japan exported 290,000 metric tons of fishery products amounting to more than $ 160 million in value, roughly 6% of Japan's total exports for the year.

Pressed by necessity, Japan has taken the lead in this industry over the past 40 years with the exception of the war years. Her average annual catch for the 1936-40 period was 4,240,000 metric tons and her fishing fleet totaled about 350,000 vessels of all sizes.

In 1955, as reported by the Food and Agriculture Organization of the United Nations (FAO), Japan caught more than 4,740,000 metric tons of fish with her 414,588 fishing vessels. This was 15.4% of the 1955 world total catch of 27,700,000 metric tons. In the same year, the United States was second, with a catch of 2,680,000 metric tons, about 2,000,000 tons less than Japan. In 1957 Japan's catch was 5,339,000 metric tons while that of the United States was 2,741,000 metric tons and the U.S.S.R 2,540,000 metric tons.

World Total And Japanese Catches (Excluding Whaling)

(Unit: Thousand Metric Tons)

Year	1938	1948	1954	1957
World Total Catch...	20,500	19,090	26,800	29,960
Japan's Catch.....	3,562	2,431.4	4,544.6	5,339

(Source: FAO Year book of Fisheries Statistics, 1955 and 1957)

Making full use of advanced technical and scientific knowledge, Japan's fishermen have discovered and developed many of the currently known fishing grounds in the open seas of the world.

Still, only about 10% of the Japanese fishing population is engaged in high seas fisheries. The operations of the remaining 90% are limited to domestic or coastal fisheries. Vessels of over 20 tons account for only about 20% of the nation's fishing fleet.

Whaling, salmon and crab fishing (North Pacific), large and medium scale trawling, tuna and skipjack fishing, and pearl shelling (Arafura Sea) are some of the Japanese high seas fishing operations. Domestic or coastal waters have a large number of species of fish and other forms of useful marine life, and account for 75% of the total catch.

High Seas Operations

1. Whaling

Japanese whalers have been active in the Antarctic, North Pacific and waters adjacent to Japan. Japan sent 6 fleets with 68 catchers to the Antarctic for the 1957-58 whaling season there. These fleets produced 107,000 tons of whale oil and 94,000 tons of edible whale meat and blubber. Of the nations which sent whaling fleets to the Antarctic that season, Japan had the second highest catch.

Recent annual statistics for North Pacific Whaling (Mother-ship type) and coastal whaling are as follows:

(Unit: Metric Tons)

Year	Number of Catchers	Whale oil (including Sperm oil)	Whale meat (fresh, frozen and salted) and other products
1953	101	10,791	29,945
1954	106	23,534	38,519
1955	100	25,276	36,457
1956	93	33,221	45,826
1957	86	33,153	42,329
1958	87	35,528	37,119

2. Mother-Ship fishing for salmon and crab in the North Pacific

As bases could not be established after the war in the Soviet-held Kuriles, Sakhalin and Kamchatka, the Japanese resorted to mother-ship operations.

In 1952 for the first time since the war, Japan sent three salmon fishing fleets on a more or less experimental basis into the waters south of the Aleutian Chain between 160°E and 180°. She had little previous fishing experience in that area

and little knowledge of the value of the fishing grounds. Japan studied the results of the experimental operations and gradually extended the scale of her operations in the North Pacific west of 175°W, the provisional abstention line for salmon fishing by the Japanese under the international (Japan, U.S. and Canada) Convention for the High Seas, Fisheries of the North Pacific Ocean, which came into force on June 12, 1953. Experimental operations by two fleets were also carried out in the Okhotsk Sea in 1955.

In addition to the mother-ship operations, there is salmon drift-net fishing based on Hokkaido in the waters south of 48°N, outside the regulation area for salmon under the Convention between Japan and the U.S.S.R. concerning the High Seas Fisheries of the Northwest Pacific Ocean of 1956.

Prewar and postwar salmon catches are as follows:

(Unit Metric Tons)

Year	Soviet Waters (1)	Mother-ship type	Kuriles: South of 48° (2)	Total
Prewar				
1936	134,889	21,493	110,085	266,477
1937	148,147	25,004	151,108	324,259
1938	111,217	24,615	161,162	296,994
1939	157,639	28,431	204,651	390,721
1940	122,506	24,919	63,048	210,473
Postwar				
1953	–	13,717	18,997	32,714
1954	–	38,115	22,001	60,116
1955	–	116,210	47,068	163,278
1956	–	92,870	48,173	141,043
1957	–	100,001	62,265	162,266
1958	–	91,618	59,379	150,997

Notes: (1) Coastal operation under the Convention between Japan and Russia including Sakhalin.

(2) drift-net and long-line.

One king crab fishing fleet has been operating each year in Bristol Bay off Alaska since 1953. In 1955, experimental operations were conducted in the Okhotsk Sea by two fleets. In 1956, the number of fleets operating there was increased to four, in addition to a fleet for the Bering Sea northeast of Cape Olyutorskity.

Postwar mother-ship king crab operations and output are shown in the following:

Table:

Year	Mothership	Attached Vessels	Grounds	Crabs Caught (pieces)	Carb Cans Produced
1953	1 (4,999 tons)	12	Bristol Bay	1,276,360	58,240
1054	1 („)	12	„	1,050,814	62,690
1955	(1 („)	8	„	1,129,163)	209,690
	(2 (11,886 tons)	23	Okhotsk Sea	3,939,140)	
	(1 (4,999 tons)	10	Bristol Bay	1,079,106)	
	(1 (5,887 tons)	12	Off Cape Olyutorskity	1,254,740))	426,350
	(4 (23,448 tons)	51	Okhotsk sea	9,535,105)	
1957	(1 (5,385 tons)	11	Bristol Bay	1,170,951)	403,850
	(4 (23,439 tons)	51	Okhotsk Sea	10,180,795)	
1958	(5 (28,877 tons)	14	(Bristol Bay) (Okhotsk Sea)	11.880,220)	379,850

These catches amount in weight to a small percentage of Japan's total catch. They are, however, of great importance to Japan's economy, because most of the canned salmon and crab meat is exported, becoming a valuable source of foreign currency for Japan.

3. Large and medium scale trawling

Otter trawlers and large trawlers have been operating mostly in the Yellow Sea, the East China Sea and the South China Sea for generations and also in the Okhotak and Bering Seas. Medium trawlers are engaged in fishing in waters around Japan, east of 130°E, especially off Hokkaido. In 1957 these fisheries with 2,181 vessels supplied more than a million metric tons of bottom fish, mostly for domestic consumption.

4. Tuna and skipjack fisheries

The restrictions imposed by the Allied Occupation on fishing grounds were abolished in 1952, and subsequently there was an improvement in the tuna export trade. As a result, tuna fishing became very active and the grounds were rapidly expanded in the seas around Hawaii to the east, the Indian Ocean to the West, and in the Southern hemisphere. Some tuna fleets with mothership have recently started operating, and tuna vessels are conducting experimental operations in the Mediterranean and the Atlantic.

Skipjack fishing is conducted mostly with pole and line in the course of the Japan Current, while tuna is caught mostly with long-line.

The recent catch by skipjack pole and line vessels and by tuna long-liners are as follows:

(Unit: Metric Tons)

Year	Skipjack pole and line fishery	Tuna long-line fishery
1952	144,525	110,063
1953	118,388	128,625

Year	Skipjack pole and line fishery	Tuna long-line fishery
1954	139,950	151,013
1955	145,238	176,363
1956	163,420	212,228
1957	168,746	238,680
1958	184,527	258,830

The fish caught in these operations are not only vital for domestic consumption but significant in the field of export trade. Tuna and skipjack exports amounted to about 37% of the total catch between 1954 and 1956.

5. Pearl-shelling in the Arafura Sea

Since the latter half of the 19th Century, a good many Japanese divers and tenders have been active in pearl-shelling in the Arafura Sea, with bases in northern and western Australia. During their most prosperous prewar years, Japanese pearl shelling vessels caught 40 to 70% (1,099-4,000 metric tons) of the world production of silver lip pearl shells.

Japanese operations are now being carried out on a much smaller scale by mother-ship fishing under the provisional Regime between Japan and Australia of 1954, pending the decision of the International Court of Justice on the disagreement between Japan and Australia concerning the fishery.

Japanese output of pearl shells in recent years is as follows:

Year	Output (metric tons)
1954	955
1955	752
1956	662
1957	713
1958	483

As mentioned above, about 75% of Japan's total catch comes from coastal waters where more than 90% of the total fishing population operates. Almost all the activities are limited to the near coastal waters. According to the Fishery Culture and Catch Statistics of 1956, about 30% of Japan's total catch was produced by small vessels of less than five tons and by non-powered vessels, and about half of the amount by vessels of less than 20 tons and by non-powered vessels.

Aquiculture

The big three among Japan's cultured marine products are pearls, oysters and seaweed. The techniques employed in these industries are highly advanced.

Oyster culture is being carried out by some 6,800 individuals in groups of all sizes, involving approximately 2,270 acres of sea bottom. The annual production of oysters is as follows:

(Unit: Metric Tons)

Year	Production (with shells)
1953	106,658
1954	102,398
1955	98,040
1956	114,386
1957	144,038
1958	151,213

Statistics for recent exports of baby oysters are given in the following table:

Year	Cases	Tons (in metric tons)
1954	53,788	4,093
1955	52,534	4,418
1956	100,619	5,129
1957	– – –	3,582
1958	– – –	3,379

Note: One case contains more than 12,000 baby oysters.

Pearl culture is a unique Japanese industry and 98% of the production is exported. Cultured pearls are often superior in shape and quality to natural pearls. Statistics for operations in recent years are as follows:

Year	No. of Operation Units	Production (kg)	Pearl exported ($1,000)
1954	1,456	16,875	7,240
1955	1,643	24,535	10,040
1956	1,734	26,620	13,300
1957	2,574	30,056	16,498
1958	2,574	31,972	17,684

International Conservation Measures

With the development of fishing techniques in recent years the scale of fishing operations by the various nations has been expanded. For this reason, concerted measures among nations concerned have become necessary to maintain the maximum sustained productivity of such resources.

Japan participated in the 1951 International Convention for the Regulation of Whaling and in 1952 became a member of the Indo-Pacific Fisheries Council, an organization of experts under FAO.

In 1952, Japan concluded the International Convention for the High Seas Fisheries of the North Pacific Ocean with the United States and Canada; and in 1956, the Convention for the High Seas Fisheries of the Northwest Pacific Ocean with the U.S.S.R.; and in 1957, the Interim Convention on Conservation of North Pacific Fur Seals with the U.S., Canada, and the U.S.S.R. (*Japanese Information Office*, 1, April 1960).

Agreement on Safe Fishing with Communist China

The conclusion of a safe fishing agreement between the Japan-Communist China Fisheries Council and the China Fisheries Association was announced on October 29, 1959, in Peiping by a joint declaration of the two contracting parties. A Japanese member of the standing committee of the Japan-Communist China Fisheries Council, signed the agreement for the Japanese side. The agreement designates two ports on the mainland, Lien Yün Kang and Wu Sung Kou, as ports of refuge for Japanese fishing boats in case of typhoon, shipwreck, accident or sickness. The Japanese named the ports of Nagasaki,

Tananoura and Yamskawa. Severe restrictions are placed on the activities of Japanese boats and men while in Chinese Communist ports, and it is specified that the agreement does not apply to cases of sickness which are of an epidemic nature. The Japan-Communist China Fisheries Council has applied to the Japanese's Maritime Safety Board of the Ministry of Transportation for official approval of the arrangement. In view of the fact the agreement deals with humanitarian questions that are "non-political in nature", approval is expected in the near future. From a practical standpoint the Japanese consider the agreement to be advantageous, because their boats frequently fish in Communist China's coastal waters while few Chinese boats approach the shores of Japan.

Building of Replacement Fishing Vessels Stepped up

An increase in building of replacement fishing vessels in Japan is aiding that country's shipbuilding and related industries. Most of the new vessels are for tuna fishing. Due to the stabilization of the tuna industry, construction tonnage has increased to almost three times as much as previous years and shipyards and ironworks are said to be holding orders for the coming six months. Compared with construction tonnage of 25,463 in 1958, by September 1959 it had reached 49,850 tons, almost twice as much. One reason for this increase in construction is the fact that a considerable amount of money is loaned out by financing institutions. Another reason is that many fishing companies and individual owners have shifted from offshore waters near Japan to distant fishing and direct exports or landings of catches at foreign ports or bases in the Atlantic. As far as the number of vessels is concerned, there does not seem to be much difference from 407 as of September 15, 1958, and 420 vessels as of September 15, 1959. But while there was a drop of 34 wooden fishing vessels, there was an increase of 47 steel vessels in the first nine months of 1959. Each firm and vessel owner is trying to improve equipment and the efficiency of the fishing vessels, and at the same time a tendency is noticeable for building larger vessels. For instance firms are building tuna vessels of the 500-2,000 ton class. According to the shipyards, all the shipowners are trying to figure out how the fish hold can be made larger in order to utilize the ship's tonnage to the maximum. For this purpose, they are making the engine room smaller and the weight of the main engine lighter. In the first nine months of 1959, vessels built or building for the skipjack tuna fishery totaled 123 as compared with 62 vessels built or building by September 15, 1958. The Japanese Fishery Agency comments that the present condition does not necessarily indicate similar activities in 1960 and some quarters in the industry seem to be of the opinion that construction tonnage may be beginning to decrease. One Japanese firm on November 5, 1959, was reported to have ordered two vessels of 480 tons each from a shipyard in Shizuoka Prefecture. Construction of these two vessels is part of the company's plans to expand its tuna fishery. After completion these vessels will be based at Misaki, Kanagawa Prefecture.

Typhoon Damage

Typhoon Sarah swept across southern Korea on September 17, 1959 and left behind an estimated 669 persons missing and almost 800,000 persons homeless. Property damage, not yet all officially listed, is estimated to have exceeded US$100 million. Hardest hit was the Korean fishing industry which had been gradually developed under joint Republic of Korea-United States overseas mission (International Cooperation Administration) assistance to the point where it had become capable of supplying Korea's need for fisheries products and to provide a surplus for export. United States fisheries technicians report that prior to 1959, a total of $3,217,000 had been provided to rehabilitate the Korean fisheries program; and that current year's operations provide an additional $480,000 in direct support from Defense Support Appropriations and $659.000 from counterpart funds. Estimated damage to fisheries installations in Kyong Sang Namdo Province, hardest hit by the typhoon, has been listed as at least 2,652,850,000 hwan ($5,305,700). Because communications with many of the areas have not yet been re-established, this total loss may rise much higher. Two other provinces, less seriously affected, may bring the total loss to the fishing industry of Korea to $18,000,000. One major phase of the United States Aid program has been to assist the Korean Fisheries Associations to rebuild, remodel, or modernize the vessels in Korea's fishing fleet. On the basis of present information over 3,000 boats including 16 of the powered vessels which were replacing former craft were destroyed. Seven other powered vessels were lost, and 15 were partially destroyed. Vessels lost, damaged or destroyed include many new craft built with USOM funds and on which the construction has been completed but the boats were awaiting the delivery of motors already in the warehouses. Damages to Government facilities for fisheries research, demonstration, inspection, processing and warehousing in the Pusan area amounted to 58,000,000 hwan ($116,000) and much of this was constructed or operated as part of the fisheries program. An additional 24,000,000 hwan ($48,000) was reported from various branch research stations and hatcheries in the Mokpo and other outlying areas. Until 17 September 1959, the USOM fisheries program for Korea had expected to report unusual progress in implementing its current program. Typhoon Sarah hasmade it necessary for the Korean fishermen—and the United States aid program to the Korean fisheries industry—to make a fresh start. Already this is being done, with special survey teams in the disaster area to investigate what can be salvaged and to meet with the various fisheries guilds to help them develop ways to finance the reconstruction. Relief aid is already moving into the disaster area, and a formal request for long-range aid assistance has been forwarded to Washington.

Fishing Industry Equipment Listed for Duty-Free Entry

The Korean Ministry of Finance issued two ordinances (Nos. 174 and 175) on 20 October 1959, which revised the existing provisions in Ordinance Nos, 54 and 55 for exemption of customs duties on certain imports. Public Notice No,

197 of 20 October 1959, issued by the Ministry of Finance spells out in detail the specific machinery and equipment entitled to duty free treatment for each important and essential industry. Duty free items concerned with the fishing industry are as follows:

Equipment for Fishing Fleet: Fishing boats (50) gross tons up, under 5 years boat-age); fish detectors; direction finders; engines; whaling guns; net hoisters; fish pumps; and fishing nets (synthetic fibre product only).

Fish Canneries: Vacuum seaming machine; can washing machine; shell removing machine; filling machine; vacuum can inspecting machine; can drying machine; sterilizing machine; magnetic thermometers; can-lid making machine and generators.

Agar-Agar Industry: Compressors; centrifugal separators; dryers; filtering machine; agar-agar packing machine; agar-agar cutters and generators.

Fish Meal and Fish Oil Industry: Fish cooking machine; compressors; grinding machine; dryers; sieves; separators; distilling apparatus; electric current inducting and adjusting equipment; temperature regulator and generators.

FEDERATION OF MALAYA

An agreement between the United Kingdom and the Federation of Malaya Governments on the establishment of the Fish Culture Research Institute, at Batu Berendam, Malacca, was signed in Kuala Lumpur by the U.K. High Commissioner, and the Minister of Agriculture & Cooperatives, Federation of Malaya on behalf of their respective Governments. The Institute had been previously administered solely by the U. K. Government but under the agreement, the Federation of Malaya will be associated in its management and administration. Both Governments will in future be represented on the Board of the Institute when this has been incorporated by legislation to be passed by the Federation Parliament. The Institute, which cost some $2,200,000, was built during the years 1955-57 with funds provided by the United Kingdom Government. The Institute was officially opened on the 21st August, 1957. The Institute was intended to serve in the first instance all tropical Commonwealth territories and indeed its scientific results will be available to all countries interested in tropical fish culture. The Institute, which lies alongside Malacca airfield, has 164 fish ponds, ranging in size from 1/100th of an acre to 4½ acres. There are well equipped laboratories with research accommodation for eight scientists. The laboratories have been designed for extension as required.

PAKISTAN

New Wholesale Fish Market

On 2 October 1959, the New Karachi wholesale fish market was opened by the President of Pakistan. The Minister of Food and Agriculture outlined the status of the fish harbor and revealed for the first time publicly the Martial Law Regulation which had been signed on 29

September 1959, whereby no one is permitted to sell or otherwise dispose of fish, fresh, dried or salted, except at places designated by the Central Government. This provision of the Martial Law applies only to wholesale auctions. Retail sales and sales by hawkers will be unaffected. The market started auction operations on 6 October at which time 60 metric tons of fish were disposed of. The quantity has increased, and the daily capacity had been estimated at 120 tons. The channel at the waterside where fishing boats were to land their catch has not been dredged to sufficient depths and catches continue to be landed elsewhere and brought into the market by camels, rickshaws and trucks, so that the planned smooth flow from the ships to the sorting room and into the auction room has not yet been effected.

But the fish harbor will be in full operation by the middle of 1960. Following is the status of the installations in the fish harbor, and the anticipated date of completion as set forth by the Government: Jetty built on the reclaimed land completed; wholesale fish market, completed; oil pier, completed; Fishermen's Cafe, completed; building for storing, display and sale of fishing equipment, completed; four sheds to be used for making and mending nets as well as the fishermen's rest house, completed; the sea food cafe, construction completed but not open pending a decision as to who will operate it; two cold storage plants, 120 tons each, completed; one chip-ice plant and 2 block-ice plants with combined capacity for freezing of 40 tons a day, completed; research station (marine fisheries laboratory), January 1960; dredging, April 1960; boat basin, workshop, and slipway for repair of vessels, no estimated date of completion but construction will not begin until after dredging has been completed; curing yard, no estimated date of completion but construction is to begin early in 1960. Private enterprise area, 37,000 square yards have been earmarked for private industry and 7 plots have been allotted. Construction has started on one freezing plant. No date of completion indicated. The other 3 freezing plants, the 2 canning plants, and 1 shark-liver plant are just now placing orders for machinery; and road net-work, the major portion of network completed.

Hilsa Fishery

The Hilsa Fishery of Pakistan is reported to provide over 400 million lbs. of protein food to the economy of the country each year. The Food and Agriculture Council of Pakistan sanctioned two schemes for Hilsa investigation, one for West and the other for East Pakistan. These schemes have been in operation since 1959 and 1956 respectively. For the East Pakistan Scheme the Food and Agriculture Council has got a vessel built by the PIDC in their Narayanganj Dockyard at a cost of Rs. 124,000. The vessel is equipped with a research laboratory and provides adequate refrigeration facilities to store fish for investigation purposes. The vessel has already been delivered to the Council and will be put in operation shortly.

PHILIPPINES

Research Vessel

The M/V MALASUGUI, research and training vessel of the Bureau of Fisheries acquired through the Japanese reparations, recently arrived from a successful exploratory fishing, the first of a series being conducted by the Bureau in connection with its long range plan to

develop the tuna fishing. Exploratory fishing, oceanographical research and training of fishermen in tuna longlining were conducted at Panay Gulf, Moro Gulf and Celebes Sea from March 14 to April 4. Inspite of the fact that only subnormal operational number of baskets, at most 103, were operated on board the vessel, yet a daily average catch of 4.5 tuna fish per hundred hooks besides other fishes, such as sailfish, barracuda and sharks was made. This shows that tuna longlining in the Philippines has excellent prospects for development and that tuna fishing in commercial scale is feasible. It is felt that the rate of catch can still be raised when more baskets can be operated as the fishermen become more proficient in the operation. The MALASUGUI is scheduled to leave again on 24 May for northern Philippine waters to resume fishing experiments. Other gear slated for demonstration and training of fishermen are deep-sea trawl and boukiami (Japanese stick-held net).

TAIWAN

Fishery Landings Increased in 1958

Salt water and pond fish production by Taiwan in 1958 amounted to 229,667 metric tons – 10.3 per cent above 1957. The goal for 1959 is 242,000 metric tons. It was reported recently that production through July 1959 reached 136,045 tons and, despite flood damage to fish ponds, the 1959 production is expected to exceed the target. Flood damage to fisheries was estimated officially at NT $76,375,000 (about US$2,117,000), almost all of which consisted of claimed damage to fresh-water ponds and to brackish coastal ponds near Tainan. A fisheries expert in September reported that the few fresh-water ponds in the flooded area had been repaired and restocked, at a total outlay to the Federal Agency of less than NT$4 million (US$111,000), and that most of the coastal ponds were better left unrepaired, since they obstruct drainage and are illegal. Thus, pond-fishery production has been little set back, and the abundance of water for ponds around Taoyuan, which frequently go dry in late summer, will probably assure an increased catch there. Certain funds were made available for rehabilitation of boats and fishing harbors. Taiwan's fishing has expanded so fast that coastal and inshore trawling grounds are becoming less profitable, and the trawlers are tempted to wander afield. They stray occasionally within reach of Communist Chinese gunboats and are taken into custody. Though they are usually released, the Government has attempted to minimize incidents by setting limits to those parts of the Taiwan Strait and China Sea in which they can operate. The trawlers have regularly ignored the limits but, after the most recent incident last spring, the Navy began more rigid enforcement, and the trawlers have complained to the authorities that, unless restrictions are relaxed, the offshore and deep-sea fishery catch will shortly begin to decline.

THAILAND

Frozen Shrimp Exports

The first shipment of frozen shrimp from Thailand to the United States took place in April 1959. The packer, with headquarters in Bangkok, has a complete processing and packing plant located in

the Government freezer there. The facility offers a holding capacity of 3,500 tons. The one company is the only packer operating in the Government warehouse at present. The initial shipment of shrimp (packed in 5-pound cartons) was the first frozen product ever shipped from Thailand. The Thailand packer expects to pack about 500,000 pounds during its first year of operation. It supplies fishermen with nets, and has secured services of Japanese technicians to teach native fishermen how to fish for shrimp with modern equipment. The packer obtains mostly white shrimp, but has secured some tiger-stripe shrimp. Most of the catch has been jumbo size with very little smaller than 10-to-the-pound. The fishing season usually lasts about nine months. (*Frosted Food Field*, October 1959.)

UNITED KINGDOM

HONGKONG

The Quarterly Report of the Agriculture, Fishery & Forestry Department for Oct/Dec. 1959, gives the following information.

Fish Landings and Prices.

Fresh fish landings were 204,029 piculs, being 18.8% over the corresponding quarter of 1958 (171,759 piculs); and salt/dried fish landings were 33,267 piculs, being 34% over the same quarter last year (24,821 piculs). The increase of fish landings is attributed to good catches obtained by mechanised deep-sea junk trawlers, long liners and company operated trawlers. It should also be noted that for one month during the corresponding quarter of 1958 most of the mechanised deep-sea junk fleet had refrained from fishing due to the unsettling effect of regulations then first imposed by the Chinese Government. The average fresh fish price decreased by 17.6% (from $74 to $61 per picul) and the salt/dried fish price decreased by 24% (from $50 to $38). These decreases resulted mainly from the low prices paid for imported fish received from China.

Review of Fishing.

Nine pairs of company-operated trawlers worked off Taya Island (near Hainan) and produced 17,433 piculs of fish. The mechanised deep-sea junk trawlers fished inshore waters of about thirty fathoms in depth, between the Ladrone Islands and St. John Island, during the months of October and November. In December they again returned to deeper water and fished in sixty to seventy five fathoms. Two pairs of these trawlers found a new ground in eighty two fathoms, from which good catches of large size Red Sea Bream and Red Snapper were taken. The deep-sea long liners did well during the first half of the quarter working to the east of Hong Kong in forty eight to fifty fathoms. Then, on account of the rough seas, it was necessary for these boats to move around to the west where, fishing south of the Ladrone Islands, catches were not quite so good. Mechanised inshore junk trawlers fished off the Ladrone Islands in sixteen to twenty fathoms with only fair results during October and November. In December a number of these boats moved around to Mirs Bay where the Hair Tail were fairly abundant. Shrimp trawlers operating around the Lema Islands did well in October but November and December marked the beginning of the slack season

for the medium size shrimp fishery. The quantity of large white shrimp taken by local boats was poor; this species of shrimp was fairly plentiful in the Chinese fishing grounds around St. John Island but the Hong Kong based shrimpers could not enter that area. Purse seiners were in their slack season, Apart from the boats in the Sai Kung area which had good hauls of cuttle fish in October and November followed by successful operations after hairtail in December, the remainder of the purse seine boats did very poorly. Some of the Cheung Chau based purse seiners engaged in gill netting for Yellow Croaker with very poor results; eighteen boats took only forty piculs throughout the season. The catch of the conger pike long liners was good, except in November. The small golden thread long liners on the other hand had very poor catches in November and December; many of them remaining in harbour most of the time due to rough seas. Most of the Pa T'eng boats were engaged in shrimp beam trawling. Twelve of these boats operated yellow croaker gill nets with poor results. The annual yellow croaker season—in former years a very important fishery—was a dismal failure. This caused much hardship among the gill net fishermen, particularly those based at Tai O, Castle Peak and Cheung Chau.

Boat Building and Mechanisation

During the quarter 190 vessels, mostly small long liners, gill netters and purse seiners, were mechanised; and forty three former mechanised fishing vessels either reverted to sailing junks or transferred to the motor trading operations. The total number of mechanised vessels with the fishing fleet is 2,683. Of the 190 mechanised vessels mentioned above, 111 were newly built fishing boats. All but six of these craft were built in Hong Kong. The estimated capacity of these 111 vessels was 29,279 piculs, the total horse-power of engines 2,020 and the cost of the wooden hulls $456,540.

Pond Fish Culture

About 3,500 piculs of fish were harvested from local ponds compared with only 1,800 piculs in the corresponding quarter of last year. The increase in production was due to the availability and fast growth rate of the grey mullet, which constituted some 40% of the total harvested. The daily supply of pond fish from China decreased from 250 to 350 piculs during the previous quarter to 150 to 300 piculs. Fish prices were about 10% higher than the previous quarter. No new fish ponds were constructed during the period under review and the total area devoted to fish culture remained 3,377½ dau chung (562.91 acres).

Fish Fry Trade

During the quarter the three exporters from China imported 2,515,500 fry into Hong Kong-1,410,000 Silver Carp; 950,000 Grass Carp and 155,500 Big Head; 2,087,550 fry of the three varieties of Chinese Carp were sold for re-export to Singapore,Labuan (British North Borneo), Phnom Penh (Cambodia), Calcutta and Taiwan. Over 150,000 fry were sold to stock local fish ponds.

Pearl Culture

Altogether 3,677 of the large *Pteria* (or "Wing") oysters were under cultivation by three licensed companies, with 1,090 oysters having been embedded with nuclei. Some 66,250 of the smaller *Pinctada* oysters had been collected and 6,808 of these were embedded with nuclei.

Fisheries Trends, Second Quarter 1959:

During the second quarter of 1959, Hong Kong marketing cooperative handled 187,492 piculs (about 25.0 million pounds) of fresh marine fish and 23,712 piculs (about 3.2 million pounds) of salted fish landed. During the same period, 4,190 piculs (about 559,000 pounds) of shrimp were handled by the Fish Marketing Organization. The average price in the second quarter of 1959 for fresh fish was HK$ 0.70 per catty (about 9.2 U.S. cents a pound). Shrimp sales were not recorded by the marketing organization after June 17 as they were no longer eligible for the United States market. During 17-day period in June only 246 piculs (about 32,000 pounds) were sold.

UNITED KINGDOM

NORTH BORNEO

The North Borneo Government has approved a proposal by the Taiyo Fishery Company Limited, Tokyo, Japan for the establishment of a local Company to carry out a deep sea fishing project on the East Coast of the Colony. The Company proposes to carry out pole and/or line fishing for bonito and small tuna which would be canned or frozen for despatch to Japan. Fishmeal would also be processed.

U.S.A.: HAWAII

The News Notes on Scientific Activities of the Honolulu Biological Laboratory, for February, March & April 1960 give the following information:

During February oceanic skipjack (*Katsuwonus*) were successfully introduced into a pool at the HBL Kewalo Basin Laboratory and are feeding in captivity. Although black skipjack and yellowfin tuna have been held in captivity for varying periods of time, this is the first time that oceanic skipjack have been so held for more than a few hours or have been induced to feed. In skipjack behavior studies, the importance of being able to successfully hold the fish in captivity is analogous to the importance of being able to culture a virus in the study of the disease caused by the virus. On February 15, four skipjack each about six pounds in weight were introduced into the pool. Two died within a week. The remaining two were induced to feed on the ninth day of captivity and are presently well established. On February 27, nine more skipjack, each about two pounds in weight, were introduced into the pool, and by the next day two of these began to feed. By the fourth day six more began to feed. The ninth, blinded in the left eye from hook injuries, has not yet fed. The major portion of this success is attributed to the elimination of manual handling of the fish. Transportation of the fish from the ocean to the pool was accomplished in such a way that the skipjack were only out of water momentarily and were touched only by a barbless hook. A portable steel, oval tank, eight by six feet and approximately two feet deep, was secured to the deck of a chartered commercial live-bait vessel. When the skipjack were hooked, the fishermen lowered the fish into the tank with enough slack in the line to allow the fish to shake off the hook. During transport, water was continually circulated within the tank.

When the vessel reached shore, the tank was lifted from the ship and immersed in the poel. A hatch in the side of the tank was opened and the skipjack were allowed to swim out of the tank into the pool. The pool is circular, 23 feet in diameter and 4 feet deep. Pumps are arranged so that sea water from an adjacent channel or saline water from a well can be pumped into the pool. As water from the well is devoid of oxygen, it is allowed to cascade down a special aerator before flowing into the pool. The only food that has been fed to the skipjack thus far has been chunks of shrimp, which have been purchased in a frozen state from commercial sources. With this significant advance in the HBL behavior studies, plans are being made for the construction of more suitable tanks and associated instrumentation in which skipjack behavior may be observed. It is planned that conditioned response studies will be undertaken. These studies will involve variables which cannot readily be controlled at sea such as sound, light and various extracts including fish blood, visceral extracts, etc., and will supplement those made at sea from the underwater observation chambers on the HBL research vessel, *Charles H. Gilbert.*

Hawaiian Skipjack

Skipjack size measurements at the cannery showed two size groups to be present in the catch. The most abundant group had a mode at 25 pounds; the other had a mode at 8 pounds. There was also an ill-defined group with a mode at 4.5 pounds. The estimated March total landings of 310,000 pounds of skipjack were slightly above average for the month. The 1960 data show that the landings to date were composed of small to very large fish. Approximately, 50 percent of the catch was fish of less than 10 pounds; 30 percent, fish of more than 22 pounds. This comparatively high percentage of large fish is somewhat typical for the January-March period. The captive skipjack continue to thrive. Five, 2-pound skipjack captured on February 27 and one, 6-pound skipjack captured on February 15 are actively feeding on frozen shrimp and squid. With the successful maintenance of these tuna in captivity, plans were made during the month for construction of larger tanks in order that the conditioned response studies may be accelerated.

Publications

Two publications were issued from HBL during March. The first, "The Application of Paper Chromatography in Identifying Tuna Larvae," by Walter Matsumoto, describes experiments in paper partition chromatography designed to determine the free amino acid content in the muscles of various tunas. The results suggest the technique has utility in a taxonomic tool for adult tunas but are inconsistant with respect to their larvae. The second publication, "Oceanography of the East Central Equatorial Pacific as Observed During Expedition EASTROPIC," by Thomas S. Austin, describes the results of a quasi-synoptio, multiple-vessel oceanographic survey of the eastern tropical Pacific conducted in the fall, 1955.

Tagged Albacore Tuna Recaptured

An albacore tagged and released off San Francisco, California, by biologists of the Honolulu Biological Laboratory, U.S. Bureau of Commercial Fisheries, was recaptured by Japanese Tuna longline fishermen about 1,000 miles southeast of Tokyo Bay, in the vicinity of Marcus Island. This fish was tagged off the Bureau's research vessel *Charles H. Gilbert* on 15 November 1956 and was recaptured by the longline vessel, *No. 2 Hayatori*

Maru of Iwate Prefecture, Japan, on 13 March 1960, after a period of 3 years and 4 months. This is the longest period thus far observed between tagging and recapture. This marked the 17th recovery of albacore tagged by the Honolulu Biological Laboratory. Other recoveries in the past have also demonstrated considerable trans-Pacific movements extending from the U.S. West Coast to the vicinity of Tokyo Bay, indicating that there is probably a single population of this valuable tuna species in the North Pacific.

U.S.A.

THE GOVERNMENT OF GUAM

The Government of Guam has now established a Division of Fish and Wildlife within its Department of Agriculture. The Headquarters of the Division will be in Agana Island and the program of assistance to development of fisheries of the area is being developed.

The Officer-in-Charge is Mr. Peter Wilson, Fisheries Biologist, who is anxious to establish contacts with fisheries workers in the region.

FAO ACTIVITIES

Technical Assistance

Prof. J.S. Dendy of U.S.A. completed his 15 months assignment as a FAO/ETAP Limnologist assigned to the Philippines Government. During his stay, he organized the establishment of a Limnological Laboratory on the Laguna de Bay. He initiated work on the study of the following: (1) Harvestable products from Laguna de Bay: fish, snails which form the food of ducks, and shrimp. (2) Non-harvestable products: study of aquatic insects, plankton. (3) Chemistry and mapping of Laguna de Bay. (4) Translation into English of the German works on lakes of Philippines.

Fellowships

Mr. Tatsuo Saito of the Fisheries Statistics Section, Ministry of Agriculture and Forestry, Kasumigaseki, Chiyoda-ku, Tokyo, Japan, has been granted a fellowship for 3 months to study at the Agricultural Economics Research Institute in the Hague from 3 October 1960. Mr. Saito will make a short stop at FAO Headquarters in Rome before proceeding to Netherlands to take up his fellowship.

IPFC AFFAIRS

Personnel: Following the transfer from this area of Dr. G.R. Fish, formerly of the Fish Culture Research Station, Batu Berendam, Malacca, the Government of United Kingdom has nominated Mr. Chin Phui Kong, Assistant Fisheries Officer, North Borneo, as its representative on the Inland Fisheries Panel of the IPFC Technical Committee I.

Mr. J.A. Tubb, Secretary, IPFC, visited East Pakistan during February/March 1960 to discuss inland fisheries development and pearl culture.

Dr. G.N. Subba Rao, Technical Secretary, Technical Committee II, visited Korea, Japan and Hong Kong during May/June 1960, where he held discussions with the IPFC Technical Committee personnel of these countries.

Circulars issued:

IPFC/Circ.60/7	"Development of One-Boat Mid-water Trawl."
IPFC/Circ.60/8	"Draft Report on Boiled Fish."
IPFC/Circ.60/9	"Boiled Fish in Vietnam—an Annexure to Draft Report on Boiled Fish."
IPFC/Circ.60/10	"Dried Fish and Shark Liver Oil Processing in Pakistan."
IPFC/Circ.60/11	"Requesting Contribution of Technical Papers for the 9th Session of the Council."
IPFC/Circ.60/12	On the new publication "Fishing Boats of the World (2)."
IPFC/Circ.60/13	"Interim Report on the Activities of the Technical Committee II."
IPFC/Circ.60/14	Report on "Radio Active Waste Disposal into the Sea."
IPFC/Circ.60/15	Invitation from Government of Pakistan to hold the 9th Session of the IPFC at Karachi.
IPFC/Circ.60/16	Requesting information for Technical Committee II Report as well as Technical Papers for the 9th Session.
FEFi 430 dated 17 June 1960	"Interim Report on Marutoku-B Plankton Nets."

30th Executive Committee Meeting

The 30th meeting of the Executive Committee of the Indo-Pacific Fisheries Council was held in Phnom Penh, Cambodia, from 12th to 19th July 1960.

Facilities for the meeting was most generously provided by the Royal Government of Cambodia and members of the Fisheries Service of Cambodia participated in technical discussions.

During the meeting, particular attention was paid to immediate problems confronting the fisheries development program in Cambodia, particularly in relation to the fisheries of the Great Lake and Tonle Sap.

It was learnt that action to establish a separate Fisheries Service and to recruit and train an increased number of personnel for this Service was well in advance.

During technical discussions, the Committee was somewhat concerned in the lack of response to questionnaires and circulars issued by Technical Secretaries of Technical Committees I and II and urged members of the Technical Committees' Panels and Special Sub-Committees to take a more active part in the Council's work.

It was recalled that Member Governments had agreed that the Council's work was of considerable value and that direct communication of technical subjects could be undertaken between members of the various Committees and Technical Secretaries.

No final date was assigned for the 9th Session of the Council but it was tentatively planned to hold the 9th Session from 6th to 23rd January 1961.

PERSONALIA

Mr. Jose I. Sulit who has been for some years an active member of the Indo-Pacific Fisheries Council and particularly of the Technical Committee II, retired from government service with the Republic of the Philippine Islands on 6 April 1960. Mr. Sulit has now accepted the position as Vice-President and General Manager of the General Fertilizer Corporation of the Philippines and has therefore felt desirable to resign from his membership of the Food Technology Panel. We wish Mr. Sulit every success, happiness and prosperity in his new post and trust that we may be able to call upon him for advice from time to time.

Mr. Silvestre V. Bersamin, Supervising Fishery Technologist and Chief of Technological Research Section, has been nominated as the member of Panel B, IPFC Technical Committee II.

Mr. K. Gopinatha Pillai has assumed change as Deputy Fisheries Development Adviser in the Indian Ministry of Food and Agriculture with effect from 25 June 1960.

Mr. Jinda Thiemmedh, Dean of the College of Fisheries. Kasetsart University, Bangkok has been awarded a Rockefeller Foundation Travel Grant for 5 months for a tour of U.S.A. and Europe. He will spend 4 months in U.S.A. and one month in U.K. and other countries of Europe.

Mr. Jae Mok Yang, has been elected as the President, Pusan Fisheries College, Korea.

Dr. A.R.K. Zobairi, Deputy Director of Fisheries (Biology), East Pakistan has taken over as Director of Fisheries East Pakistan in place of Dr. Nazir Ahmad who is now the Director of Fisheries, West Pakistan.

CURRENT READING

Fishing Boats of the World-2:

Notice has been received of the publication of "Fishing Boats of the World No, 2" based on papers and discussions at the world Fishing Boat Congress organised by FAO. This volume is available from Fishing News Ltd., 110 Fleet Street, London, E.C. 4 and the price is £7.7.0, postage 5 s. Fishing Boats of the World No. 2 contains 55 major papers by experts. The papers are illustrated by about 1,000 plans, diagrams, illustrations and tables of technical data. Summaries of the contents of each article are given in French and Spanish. The compilation and editing of this work was undertaken by Mr. Jan-Olof Traung, Chief of Fishing Boat Section, Fisheries Division, FAO Rome.

UNESCO Marine Sciences Newsletter

Issue No. 2 for March 1960 of the new publication has just been received and is concerned mainly with the reproduction of the most information and valuable report on marine biology in the central Indo-Pacific region. This report was prepared by Dr. R. Serene of the Oceanographic Institute of Nhatrang, Vietnam, and was originally presented at the Regional Meeting of specialists in marine science convened by Unesco in Saigon, January 1959. Designed to draw attention to the existing knowledge and to the extensive deficiencies in this knowledge, Dr. Serene's report is of the utmost value to biologists and fisheries workers in the region. Copies of the Marine Science Newsletter No. 2 which

also contains a review of Unesco's action in this field in South-East Asia and other regions may be obtained by application to the Unesco Science Cooperation Office for South-East Asia, Djl. Diponegoro 76, P.O. Box 2313, Djakarta, Indonesia.

Studies of Pearl by S. Kobayashi & N. Watabe, 1959, Published by Gihodo Tokyo, Japan (In Japanese, with English Contents).

This is a comprehensive review of current knowledge on pearl culture and biological implications and studies related thereto. The book is divided into 4 parts, the first dealiug with pearl culture as such and describing the technique and management practices. Part 2 gives a brief review of the history of studies on shell, and pearl formation and of pearl culture in Japan. Biological studies on pearl and pearl oyster are described in considerable detail in Part 3, with particular attention being paid to physiological studies on the Japanese pearl oyster, the mechanism of nacre secretion and the analysis of the meat in the Japanese pearl oyster. Part 4 of the book gives a detailed account of the biocrystallography of pearl including general descriptions of the pearl and of the shell of the pearl oyster, studies on the crystal form and the arrangements of crystal in both shell and pearl and the descriptions of the chemical and physical properties of the hard parts. The book is well provided with tabulations of data and the illustrations, are generally clear and explicit. References mentioned in the text are quoted as footnotes and there is a useful bilingual index.

A. Von Brandt. *Fangmethoden in der Sardinenfischerei* (*CATCHING METHODS IN THE SARDINE FISHERIES*). **Protokolle zur Fishereitechnik.** Heft 26. Bd. VI, published by the Institut für Netz-und Materialforschungsanstalt für Fisherei in Hamburg. This publication prepared by the German Institut for Net Research and Material Research, describes the methods of catching of sardines and related species. The paper was submitted to the FAO World Scientific Meeting on the Biology of Sardines and Related Species held during 14-21 Sept. 1959 in Rome.

The contents are as follows:- Introduction; Catching of Pelagic Shoaling Fishes; Useful Equipments to the Sardine Fishery; Catching Methods in Sardine Fishery:

Enveloping nets, seines, gill nets, cast nets, traps, dip & lift nets, hooks, trawls, wider developments; Important catching methods in the world sardine fishery: This paper describes the sardine catching methods used throughout the world including the Indo-Pacific Region; Conclusions; Bibliography, Subject Index.

GFCM Proceedings Vol. V

Volume V of the "Proceedings and Technical Papers" of the General Fisheries Council for the Mediterranean (GFCM), containing 75 technical papers presented at the last GFCM meeting and the agenda for the next GFCM meeting,has just been published by FAO. The 535-page volume contains a summary of the plenary sessions and the adopted report of the Council's fifth meeting, held at FAO headquarters, Rome, in 1958. The adopted report contains the GFCM's program of work for 1959-60 under the headings of Marine Resources, Production, Utilization, Inland Waters and Economics and Statistics. It also forms the technical agenda for the GFCM's sixth meeting, which will be held at FAO headquarters

from 22-28 September. The technical papers, prepared by fisheries experts in the Mediterranean region, and by some European authors not in the Mediterranean area, have been edited by the GFCM secretariat in liaison with the authors. They are in English or French and each has a short summary in both languages. These papers cover practically all the fields of interest to the fishing industry Papers deal with specific instances concerning the study of fish biology; the studies of fishing grounds, fishing gear and methods; fish transportation, processing, preservation and distribution; boats; inland waters; sanitary control of fish products; social security for fisherman, and statistical studies. A volume of "Proceedings and Technical Papers" is issued after each GFCM meeting. The GFCM meetings are held once every two years. The book is on sale for $5.- or £1. 5s. 0d. through sales agents of FAO publications.

MEETINGS AND CONFERENCES

Technical Meeting on Credit for Fishery Industries

Invitation have been to FAO's member nations to a technical meeting on Credit for Fishery Industries, October 17-22. The meeting will be held in Paris at the invitation of the French Government. The meeting in general will discuss government credit programs in terms of their administration, operation, and effectiveness. It may be emphasized that it is not the purpose of the meeting to discuss whether or to what extent governments should or should not assist fishery industry through the extension of credit. But the exceptional risks connected with the production and distribution of fish have made it difficult for the industry to obtain private credit on acceptable terms. Governments, having assumed increasing responsibility in supplying or guaranteeing credit to fishing, have had an increasing number of problems in organizing and operating credit schemes. Many of these problems are connected with the operation of new schemes. What procedures can be applied in awarding lone funds, in collecting repayments ? What security can borrowers be required to furnish ? And how can the costs of administration schemes be cut to a minimum ? Those are some of the tropics which will be discussed at the meeting. Countries with less-developed fisheries and limited funds have a special interest in the efficient use of credit funds. In some cases, schemes had been unsuccessful because of mistakes in design and administration. The discussions at the meeting are planned to help avoid such mistakes in the future.

European Inland Fisheries Advisory Commission

An organization designed for discussion and combined action on common problems of European inland fisheries will hold its first meeting from 25-30 April at Dublin, Ireland. The new group is known as the European Inland Fisheries Advisory Commission (EIFAC) and is sponsored by FAO. All European members of FAO have been invited to the meeting as participants or as observers. Fourteen countries have already signified their desire to become commission members. Five international organizations, involved in work related to fisheries, have been invited to attend as observers.

The new commission resulted from a meeting of an inter-governmental group of inland fisheries experts in Helsinki, Finland, in 1956. This group recommended that FAO establish an organization to meet the specific needs of European inland fisheries services. Although European fish culture has already reached a high degree of development, the pooling of research methods and techniques should increase food production far beyond that achieved by traditional means. This commission is planned as a means to present discussion and take combined action on problems common to the freshwater fisheries of Europe. Among these are prevention of water pollution, control of aquatic weeds and fertilization of fish ponds, and removal of predatory fish. At its first meeting, the commission is expected to extablish its rules of procedure and to set up its internal structure.

Scientific Conference on Disposal of Radioactive Wastes

A scientific conference on disposal of radioactive wastes resulting from the peaceful uses of atomic energy was held at the Oceanographic Museum in Monaco from 16 to 21 November 1959. The conference was sponsored jointly by the International Atomic Energy Agency and Unesco with the active cooperation of the FAO. More than 300 scientists from 32 countries participated in this conference. The theme of their discussions can be stated as follows: how to get rid of radioactive waste. Unlike normal industrial waste, it cannot be merely thrown away or burned. Some way must be found either for storing the by-products of atomic research and industry safely until their radioactivity disappears (in some cases it means hundreds of years), or else treating them to the point where they can be discharged without any danger into rivers, oceans or the atmosphere. The conference probably did a good deal to clear up two general misconceptions about the peaceful uses of atomic energy. In the first place, it was brought out that waste products, at present, represent far less man-made radioactivity than the fallout from nuclear explosions. Secondly, the postulate that atomic energy is a power source which can be used universally seems to be considerably restricted. No one can build a nuclear power plant just anywhere. Careful studies of geological formations are needed if the waste from the plant is to be buried underground. Equally careful research into marine life, currents, the geology of the bed of the sea has to be carried out before waste can be disposed of into the sea. In this respect it seems that entire bodies of water—such as the Mediterranean or the Baltic—should be ruled out as radioactive waste disposal sites becuase of their specific oceanographic features. Burial into the ground appears to be the safest way of getting rid of unwanted fission products, although in densely populated areas this method is not acceptable. A scientific disagreement arose during the discussion on the methods of the safe disposal of radioactive waste into the sea. Some participants maintained that water from great depths takes from 500 to 1,500 years to move to the surface, while others stated that the period is only 50 years, adding that marine organisms such as fish and plankton can transport radioactivity through the various layers of the sea. The conclusions of this discussion—and perhaps of the entire conference—were summed up clearly by Mr. Roger Revelle, the Director of the Scripps Institution of Oceanography. He declared:

"In my opinion, this discussion shows that ten times as much money and facilities are needed for research. The Russians say that no radioactive waste should be put into the ocean. The British say they know how to put it in safely".

Previously the conference heard a plea from a Soviet scientist, Mr. V.I. Spitzyn, for closer relations between oceanographers on the one hand and physicists and chemists on the other. The meeting at Monaco probably took a long step forward to bringing about such closer relations, both among various branches of science and among scientists from various nations and regions. It also proved quite forcefully, that the disposal of radioactive wastes, like so many other problems facing this world, cannot be solved unilaterally by any single nation.

International Oceanographic Congress

How many fish are there in the sea, and where they are and how their number can be increased to feed the ever-increasing human population of the earth were practical questions in the background of one session of the International Oceanographic Congress at the United Nations in September 1959. But no one among the 500 experts from 38 countries knew the answers. The great need for human nutrition is protein and fish is a rich source of proteins. If they could be raised as beef on fertile watery farms and ranges their numbers could be increased enormously and the fish themselves would grow to much larger size. But their growth and numbers are limited by the amount of food they can find. Increasing fish production requires an increase in the microscopic fish food called plankton on which fish life depends. A plankton census must precede a fish census. Studies of plankton made by the Scottish Oceanographic Laboratory were reported to the Congress. These microscopic plants and animals occur in astronomical numbers in most sea water. More than 50,000 samples of plankton were analyzed annually and each was separated into about 100 different species to discover where each is most plentiful. A plankton map of the North Sea and the nearby parts of the Atlantic and Arctic oceans will soon be published as a guide to the fish-feeding grounds. Extension of such a map to the entire ocean and to a world fish sensus is being discussed as a major project in the near future for one of the international organizations such as UNESCO or the International Council of Scientific Unions. Meanwhile there have been some successful transplantations of young fish over long oceanic distances to better feeding grounds. This was done for the European place with a large increase in the catch at the new location. The striped sea bass has been successfully transferred from the Atlantic to the Pacific. But every attempt to grow Atlantic shore oysters in the Pacific has failed. Much research will be needed on sea plants and small animals before any effect can be expected on the catch of edible fish. A professor of Cambridge University in English reported to the Congress on the fantastic forms that have developed among fishes of the great deeps of the ocean – fish with months that extend half the length of their bodies, stomachs that can be extended to permit a fish to devour a fish larger than itself, and luminous bait that some fish carry before them on long antennae-like organs to attract their food. The reason for the existence of these queer fish is unknown

but the professor claimed that the absolutely unchanging environment in the dark depths of the sea would permit mutation to run wild over millions of years. In the deep trenches that sink a mile or more below the great plains of the sea bottom, the odd species that develop in one trench may be quite different from those in a neighboring trench.

Regional Training Course in Marine Sciences

During the period 17 August to 13 December 1959, a regional training course was held at the Institut Oceanographique, Nhatrang, Republic of Vietnam, under the sponsorship of the Unesco Science Cooperation Office for Southeast Asia and with the Government of the Republic of Vietnam acting as host. The course was under the general direction of the Director of the Institute, Dr. Nguyen Dinh Hung. Thoughout the period, instruction in marine biology was given by Dr. Jorgen Knudsen of the Zoological Museum, Copenhagen. Course were also given by Dr. Warren S. Wooster (physical and chemical oceanography) and Dr. Douglas L. Inman (sedimentation and shore processes) of the Scripps Institution of Oceanography, La Jolla, USA, and by Dr. David Rochford (hydrology of the inshore waters) of the Commonwealth Scientific and Industrial Research Organization's Marine Laboratory, Cronulla. In addition, instruction was given by Dr. Raoul Serene of the Nhatrang Institute (crustaceans, corals), Prof. Saurin (marine geology), Prof. Pham Hoang Ho (marine algae) and Prof. Weis (diving) of the University of Saigon. Lectures were also given by Prof. Anton F. Bruun, Prof. Roger Revelle, and Prof. Ralph Buchsbaum.

Instruction consisted of lectures, field-trips and laboratory work. The principal teaching approach was that of field laboratory workshop, utilizing the natural biological, hydrological and sedimentological environments in the vicinity. Mimeographed lecture notes were distributed and frequent examinations were held. From two to four field trips were made each week, and the results worked up later in the laboratory. The important text books in marine sciences were available, and large portions of these were assigned for reading and study.

The trainees also participated in some field trips on board the *Stranger*, research vessel of the Scripps Institution of Oceanography at present carrying out oceanographic investigations in the South China Sea and Gulf of Thailand. It is also hoped that it will be possible to offer to the trainees as a follow-up of the course to participate in 1960 during a period of up to two months in the work of this expedition. The following countries have sent trainees to the course: Cambodia (1), Republic of China (2), Indonesia (4), Hong Kong (2), Japan (2), Republic of Korea (2) the Philippines (3), Thailand (3), and the Republic of Vietnam (5). Altogether 24 trainees were admitted to the course. They were awarded a UNESCO fellowship, which covered both their travel expenses from and to their home country, and their living expenses in Vietnam during the period of training. A very valuable assistance was extended for the course by the Government of Vietnam, which acted as host. Special premises for lodging the trainees were constructed for the purpose by the Vietnamese authorities, and teaching and technical staff and laboratory facilities were made available for the participants by the Oceanographic Institute of Nhatrang.

Tenth Pacific Science Congress

The Tenth Pacific Science Congress of the Pacific Science Association will be held at the University of Hawaii, Honolulu, from 21 August to 6 September 1961, sponsored by the National Academy of Sciences, Washington, D.C., and Bernice P. Bishop Museum, with the cooperation of the University of Hawaii. Scientific sessions will be held from 21 August to 2 September, with a post-sessional field trip through 6 September. Each Pacific Science Congress is held under the auspices of the organization which represents the Pacific Science Association in the host country. The Pacific Science Association is an international, regional, non-governmental scientific organization, founded in 1920 by the holding of the First Pan-Pacific Scientific Conference in Honolulu. The Association's permanent headquarters is at the Bishop Museum, Honolulu 17, Hawaii, U.S.A. At its meeting during the Ninth Congress, at Bangkok in 1959 the Council of the Association accepted the invitation for the Tenth Congress to meet in Hawaii in 1961.

The program is being organized under Sections and Divisions. Symposia are the main divisional meetings, but provision is also being made for sessions of grouped papers and sessions of contributed papers. In addition to sectional and divisional programs there will be a limited number of special symposia of broad general interest. The Section on Biological Sciences has four Divisions, two of which are of interest to fisheries workers. These are: Division of Marine Biology and Fisheries and Division of Limnology and Freshwater Fisheries.

IGY METEOROLOGICAL MICROCARDS

The July 1960 issue of the World Meteorological Organization Bulletin, Vol. IX, No. 3, carries with it a sample microcard, one of the set of Microcards of IGY Meteorological Data published by the World Meteorological Organization. On this single card are reproduced no less than 1,600 complete surface synoptic observations. They were made at 6-hourly intervals from 82 stations over the 5-day period 5 to 9 July 1958. The figures on the Microcard are about 20 times smaller than the original. They may be read with a good lens of 10 times magnification. For regular use, however, a special Microcard reader is recommended. The whole of the IGY synoptic meteorological observations are available on about 16,000 Microcards (equivalent to several hundred printed volumes). They may be purchased in complete sets, in partial sets covering limited types of observation, limited areas and limited periods of time, or as single cards. The IGC 1959 aerological observations are now being published in the same way. The complete set of the Microcards is priced at US $5,990 and further enquiries should be addressed to the Secretary-General, WMO, Geneva.

FORTHCOMING FAO MEETINGS AND TRAINING CENTERS OF FISHERIES INTEREST

1960

Date	Subject of Conference	Convening Body and/or Organizers	Location
July 28	General Assembly of the International Union of Geodesy and Geophysics (UGGI), International Association of Physical Oceanography (IAPO), Ocean Floor meeting	UGGI	Helsinki
July 30	UGGI General Assembly, IAPO and Int. Association of Geodsy, Meeting on the Mean Sea Level in Europe	–do–	Helsinki
July	International Association of Scientific Hydrology	–do–	Helsinki
July/Aug.	UGGI General Assembly, IAPO, Meeting on the Variation in the overflow of submarine ridges, Iceland and Greenland ridges.	–do–	Helsinki
July/Aug.	UGGI General Assembly, IAPO, Meeting on Ocean Circulation	–do–	Helsinki
28-29 July	UGGI General Assembly, IAPO and International Association of Scientific Hydrology, Meeting of Tidal Rivers	–do–	Helsinki
July/Aug.	UGGI General Assembly, IAPO, Meeting on Optics of the Sea	–do–	Helsinki
3 Aug.	UGGI General Assembly, IAPO, and International Association of Meteorology, Meeting on the Circulation of CO_2 in the Atmosphere of the Ocean	–do–	Helsinki
5 Aug.	UGGI General Assembly, IAPO, Meeting on Chemical Oceanography	–do–	Helsinki
5–6 Aug.	UNECOSOC–30th Meeting	UNECOSOC	Geneva
25 Aug./ 11 Sept.	National Fisheries Fair	—	Bergen
12–17 Sept.	CCTA–Symposium on Marine Biology and the Fisheries of East Africa	CCTA	Cape Town
19–28 Sept.	ICES–48th Meeting International Council for the Exploration of the Sea	—	Moscow
22–28 Sept.	General Fisheries for the Mediterranean–6th Session	M.J. Girard (FAO)	Rome
26–30 Sept.	IAEA Panel on Radioactive Waste Disposal into Freshwater	IAEA	Vienna
26 Sept./ 8 Oct.	6th International Technical Conference on Light Houses & other Aids to Navigation	—	Washington
5–10 Oct.	Mean Sea Level-IAG	—	Liverpool
17–22 Oct.	FAO Technical Meeting on Credit to Fishing Industry	C. Beever (FAO)	Paris
17–28 Oct.	FAO Council–34th Session	—	Rome
14–18 Nov.	IAEA–Symposium on Nuclear Ship Propulsion	IAEA	Undet
14–23 Nov.	FAO Regional Conference for Asia and the Far East–5th Meeting	FAO	Saigon

TRAINING CENTERS AND SEMINARS

Date	Subject of Conference	Convening Body and/or Organizers	Location
1 Sept./15 Oct.	FAO/ETAP Fisheries Training Center	P. Lusyne	Suez
Oct. (8 days)	Seminar on Community and Home Food Preservation	Mr. Holmes	Poland or Switzerland

1961

MEETINGS

1 Quarter	Indo-Pacific Fisheries Council-9th Session	J.A. Tubb	Karachi
Undet	FAO International Meeting of Fish Processing Technologists	E. Heen	Undet

TRAINING CENTERS

Feb./Mar. (6 weeks)	FAO/ETAP Fish Processing Training Center	E. Heen	Manila
Autumn	FAO/SPC Fisherman's Training Center	SPC	South Pacific Commission Area

IMPORTANT IPFC PUBLICATIONS

PROCEEDINGS (Records of Council Sessions.)

*First Meeting, Singapore, 24 - 31 March 1949

Section I:	Report of Proceedings
Section II:	Working Papers
Section III:	Contributed Papers
Section IV:	Symposium Papers

Second Meeting, Cronulla, N.S.W., Australia, 17 - 22 April 1950

Section I:	Report of Proceedings
Section II:	Technical Papers
Section III:	Symposium Papers

Third Meeting, Madras, India, 1-16 February 1951

Section I:	Report of Proceedings
*Section II:	Technical Papers
*Section III:	Symposium Papers

Fourth Meeting, Quezon, Philippines, 23 October - 7 November 1952

Section I:	Report of Proceedings
*Section II:	Technical Papers and Symposium Papers

Fifth Meeting, Bangkok, Thailand, 22 January - 5 February 1954

Section I:	Report of Proceedings
*Section II:	Technical Papers
Section III:	Symposium Papers

Sixth Session, Tokyo, Japan, 30 September - 14 October 1955

Section I:	Report of Proceedings
Section II:	Technical Papers
Section III:	Symposium Papers

Seventh Session, Bandung, Indonesia, 13 - 27 May 1957

Section I:	Report of Proceedings
Section II:	Technical Papers
Section III:	Symposium Papers

Eight Session, Colombo, Ceylon, 6 - 22 December 1958

Section I:	Report of Proceedings
Section II:	Technical Papers (in Press)
Section III:	Symposium Papers (in Press)

(* Items so marked are out of print.)

CURRENT AFFAIRS BULLETIN

No. 1-28, July 1951 - August 1960 (*1-21, 23)

SPECIAL PUBLICATIONS (Irregular)

*No. 1: Schuster, W.H. (1952). Fish Culture in Brackish-water Ponds of Java 1 - 143 pp.

*No. 2: Anonymous, (1952). Fish Culture in Indonesia. 1 - 126 pp.

No. 3: Zaneveld, J.S. (1955). Economic Marine Algae of Tropical South and East Asia and their Utilization. 1 - 55 pp.

No. 4: Anonymous, (1958). Annotated Bibliography on Fishing Gear and Methods.

MISCELLANEOUS

Directory of Fisheries Institutions—Asia and the Far East.

1960 OCCASIONAL PAPERS (Irregular, Mimeo)

No. 60/1 *Tilapia mossambica* (Peters)—Preliminary findings in Netherlands New Guinea, by G.A. Reeskamp Jr.

No. 60/2 Preliminary List of the Fishes of Rajasthan, by G.R. Chaturvedi.

No. 60/3 "One-Man" Measuring Board, by T. Williams.

No. 60/4 Bibliography of Fish Behavior.

No. 60/5 The Use of Non-Defatted Fish Meal for Rearing Domestic Ducks, by R. Lafont and Dr. M. Huard.

(* Items so marked are out of print.)

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